



IMPERIAL AGRICULTURE

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# PROCEEDINGS

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<i>pinquus</i> , <i>E. igneipennis</i> , <i>E. buccatus</i> , <i>E. pectinatus</i> , <i>E. brevicornis</i> , <i>E. callipterus</i> , <i>E. crassisculptus</i> , <i>E. concavus</i> , <i>E. infumatus</i> , <i>E. alticola</i> , <i>E. dilutipes</i> , <i>E. purpureus</i> , <i>E. ornatus</i> , <i>E. subimpressus</i> , <i>E. nigribasis</i> , <i>E. rufobalteatus</i> , <i>E. angustus</i> , <i>E. convergens</i> , <i>E. angustoralis</i> , <i>E. ruficoxalis</i> , <i>E. erythrogaster</i> , <i>E. concoloripes</i> , <i>E. coloradensis</i> , <i>E. alternatipes</i> , <i>E. bituminosus</i> , <i>E. dichrous</i> , <i>E. corvinus</i> , <i>E. anthracinus</i> , <i>E. geminus</i> , <i>E. persimilis</i> .	Pages
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New variety: *Exetastes nervulus intermedius*.

New names: *Exetastes bifencstratus*, *E. rugosus*.

New combinations: *Xenoschesis cinctiventris* (Ashmead), *Euryproctus clavatus* (Provancher), *Lissonota consimilis* (Cresson), *Exetastes nervulus* var. *rufofemoratus* Provancher, *E. n.* var. *exploratus* Davis, *E. n.* var. *niger* Cresson.

FISHER, WALTER KENRICK. Hydrocorals of the North Pacific Ocean. No. 3024. March 8, 1938 <sup>1</sup> -----	493-554
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New species: *Stylaster elassotomus*, *S. cancellatus*, *Allopora polyorchis*, *A. campyleca*, *A. moseleyana*, *A. brochi*, *A. stefnegeri*, *A. petrogapta*, *Cryptohelia trophostega*, *Errinopora nanneca*, *E. zarhyncha*, *Distichopora borealis*.

New subspecies: *Stylaster gemmascens alaskanus*, *Allopora campyleca paragea*, *A. c. tylota*, *A. c. trachystoma*.

New forma: *Allopora moseleyana leptostyla*.

GILMORE, CHARLES W. On the detailed skull structure of a crested hadrosaurian dinosaur. No. 3023. October 12, 1937 <sup>1</sup> -----	481-491
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GREENE, CHARLES T. The pupa of <i>Myocera tabanivora</i> Hall (Diptera). No. 3012. April 6, 1937 <sup>1</sup> -----	217-218
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HALL, DAVID G. New muscoid flies (Diptera) in the United States National Museum. No. 3011. April 6, 1937 <sup>1</sup> ---	201-216
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New species: *Hylemya abdena*, *Zenillia (Sisyropa) nox*, *Myocera tabanivora*, *Sarcophaga dentifera*, *S. tridentata*, *S. minutipennis*, *S. abnormalis*, *S. paulina*, *S. dampfi*, *Phaonia puloa*.

HEINRICH, CARL. Moths of the genus <i>Rupela</i> (Pyralididae: Schoenobiinae). No. 3019. July 3, 1937 <sup>1</sup> -----	355 388
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New species: *Rupela labeosa*, *R. liberta*, *R. pallidula*, *R. segregata*, *R. gibbera*, *R. saetigera*, *R. vexativa*, *R. cornigera*, *R. imitativa*, *R. sejuncta*, *R. scitula*, *R. adunca*, *R. lumaria*, *R. horridula*, *R. spinifera*, *R. monstrata*, *R. antonia*, *R. bendis*, *R. canens*, *R. drusilla*, *R. edusa*, *R. faustina*, *R. gaia*, *R. herie*, *R. jana*, *R. candace*, *R. lara*, *R. maenas*, *R. nereis*, *R. orbona*, *R. procula*.

JACKSON, ROBERT TRACY. Mexican fossil Echini. No. 3015. June 12, 1937 <sup>1</sup> -----	227-237
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New species: *Stomopneustes pristinus*, *Clypeaster marinus*, *C. topilanus*, *Laganum leptum*, *Eupatagus mexicanus*, *Lovenia mexicana*.

<sup>1</sup> Date of publication

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KELLOGG, REMINGTON. Annotated list of West Virginia mammals. No. 3022. October 7, 1937 <sup>1</sup> -----	443-479
LOOMIS, H. F. Crested millipeds of the family Lysiopetalidae in North America, with descriptions of new genera and species. No. 3006. May 15, 1937 <sup>1</sup> -----	97-135
New genera: <i>Diactis</i> , <i>Tynomma</i> , <i>Colactis</i> , <i>Heptium</i> .	
New species: <i>Spirostrephon texensis</i> , <i>Diactis soleata</i> , <i>D. triangula</i> , <i>D. frontifera</i> , <i>Tynomma sedecimum</i> , <i>T. consanguineum</i> , <i>Colactis saxetana</i> , <i>C. baboquivari</i> , <i>C. sideralis</i> , <i>C. protenta</i> , <i>C. quadrata</i> , <i>Heptium carinellum</i> , <i>H. scamillatum</i> .	
LYNCH, JAMES E. A giant new species of fairy shrimp of the genus <i>Branchinecta</i> from the State of Washington. No. 3025. December 3, 1937 <sup>1</sup> -----	555-562
New species: <i>Branchinecta gigas</i> .	
MYERS, GEORGE S. Report on the fishes collected by H. C. Raven in Lake Tanganyika in 1920. No. 2998. September 24, 1936 <sup>1</sup> -----	1-15
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----- . Notes on phallostethid fishes. No. 3007. January 6, 1937 <sup>1</sup> -----	137-143
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The deep-sea zeomorph fishes of the family Grammicolepidae. No. 3008. January 18, 1937 <sup>1</sup> -----	
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----- . Synopsis of the Puerto Rican beetles of the genus <i>Mordellistena</i> , with descriptions of new species. No. 3020. June 26, 1937 <sup>1</sup> -----	389-399
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New family name: Microdesmidae.	
New species: <i>Microdesmus hildebrandi</i> .	

<sup>1</sup> Date of publication.

SANDHOUSE, GRACE A. (See Clark, Austin H.)

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SCHAUS, WILLIAM. New species of moths of the family  
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No. 3026. December 29, 1937 <sup>1</sup>----- 563-584

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ary 8, 1937 <sup>1</sup>-----

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WETMORE, ALEXANDER. Two new species of hawks from  
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1936 <sup>1</sup>-----

73-78

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----- Observations on the birds of West Virginia.

No. 3021. August 24, 1937 <sup>1</sup>----- 401-441

ZELIFF, C. COURSON. A new species of trematode from the  
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<sup>1</sup> Date of publication.

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## REPORT ON THE FISHES COLLECTED BY H. C. RAVEN IN LAKE TANGANYIKA IN 1920

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THE PRESENT paper deals with a small collection of fishes obtained by Harry C. Raven for the United States National Museum during the Universal Films Co. expedition to East Africa in 1920. None of the specimens is over 3 or 4 inches in length. They were obtained with a small seine in shallow water, chiefly at two localities, Ujiji and Kigoma, on the east shore of Lake Tanganyika. Several of them represent the young of larger species, while others are the adults of the smaller, shallow-water forms.

The fish fauna of the East African lakes is of great interest. It is composed largely of perciform fishes of the family Cichlidae, which here present a vast and confusing array of closely related forms, mostly autochthonous in single lakes. Particularly in Lakes Tanganyika and Nyasa, the cichlids (see especially Regan, 1920a, 1920b, 1921, 1922, and Trewavas, 1935) form faunas so rich in genera and species as to be scarcely comparable to any others in the world. These two rift valley lakes are probably no older than the Pliocene, and the present cichlid fauna of each has evidently developed from two or three ancestral forms that gained access to the lakes not long after their formation. This evolution of varied but closely related



forms from a single or few ancestors, which suddenly gained access to a vast, deep, unoccupied lake provided with innumerable ecological niches, has happened elsewhere, though to a lesser extent. The barbine cyprinids of Lake Lanao, the cottoids of Lake Baikal, and *Orestias* in Lake Titicaca are examples in point.

In lakes that give free access to the surrounding fauna, the various ecological niches are normally filled by fishes of diverse groups. Where access has been limited, and these niches have been filled through the recent modification of one or a few closely related forms, a rather peculiar situation arises. Certain of the evolved species develop unusual modifications, body forms, and physiognomies, very unlike those exhibited by members of the particular group elsewhere. Among the Tanganyika cichlids the *Aspro*-like *Asprotilapia* and *Enantiopus*, the *Anthias*-like *Cyathopharynx*, and the blenny-like *Telmatochromis* are examples. In Lake Lanao (see Herre, 1924 and 1933), certain species of cyprinids (*Mandibularca resinus*, *Spratellacypris palata*, *Puntius tras*) have developed very peculiar characters and physiognomies, although all the Lanao species have probably evolved rather recently from a single ancestral *Puntius*. These peculiarly adapted or modified lake genera present numerous difficulties to the taxonomist. While they probably are (in Tanganyika and Lanao at least) younger than most of the genera outside the lake, they often far surpass the latter in the extent of their anatomical modifications. Such matters make it difficult or impossible to reflect the true lines of phylogeny in any general scheme based purely on the degree of morphological difference observed in the existing forms.

Another peculiarity in these autochthonous lake faunas, in part inseparable from the great divergence among closely related forms discussed above, should be mentioned. In the evident "hurry" of evolving forms to fit ecological niches, it frequently happens that the change in minor characters of anatomy or color, or characters usually found to be of only specific value, has fallen behind the change in more striking features, usually taken to be of generic significance. To me this indicates rather clearly that these "generic" characters are phylogenetically young. Regan (1922, pp. 158-159) has noted some peculiar minor characters that run through series of genera and species of the African lakes and often enable one to tell at a glance from which lake a certain species comes. To the instances he cites may be added the tendency of many of the Victoria cichlids to retain a few light-centered ocelli on the posterior part of the soft anal fin. These ocelli are seldom seen in the Nyasa or Tanganyika species, or, if present, they are usually in a different position.

Identification of the cichlids of the African lakes is rather difficult for one who is not familiar with them and who has little or no comparative material at hand. Not only are many of the species very similar, but the major grouping is based on skeletal modifications that require some skill and practice for their proper use. It is therefore with sincere thanks that I acknowledge the kind help of Dr. Ethelwynn Trewavas, of the British Museum, in the examination of the upper pharyngeal apophysis of a cranium of *Simochromis babaulti* and in the comparison of specimens of *Telmatochromis* with the types of *T. temporalis*.

### Family CYPRINIDAE

#### ENGRAULICYPRIS MINUTUS Boulenger

Five specimens, U.S.N.M. no. 84120, 17 to 35 mm in standard length, from Ujiji, have lost all their scales. Back brownish, sides and opercles brilliant silvery. Anal rays 22 or 23.

### Family BAGRIDAE

#### CHRYSICHTHYS MYRIODON Boulenger

One small specimen, U.S.N.M. no. 84131, 35 mm in standard length, from Ujiji, seems to belong to this species.

### Family CYPRINODONTIDAE

#### Subfamily LAMPRICHTHYINAE

Lamprichthyinae FOWLER, 1916, p. 416.—MYERS, 1931, p. 11.

The combination of numerous vertebrae, ctenoid scales, scaled lunate caudal fin, connected pelvic fins, presence of the basisphenoid, closely scaled preorbital, silvery color, and compressed, atherinid-like form trenchantly distinguishes the sole member of this subfamily from all other cyprinodonts.

#### LAMPRICHTHYS TANGANICANUS (Boulenger)

One small specimen, U.S.N.M. no. 84107, of this interesting endemic cyprinodont, from Ujiji, has unfortunately become dried. Besides this, I have examined a fine adult from Mpala, U.S.N.M. no. 92962, collected by Cunningham, and two others, Musée Congo Belge no. 2850, kindly loaned by Dr. H. Schouteden.

Body and head greatly compressed. Axis of body not angulated. Scales ctenoid. Pectoral fins set high, upper limit of their base above middle of depth at this point. Caudal lunate, closely covered with fine scales for half its length. Anal fin very long, rays 27 to 30. Dorsal shorter, rays 13 to 16, its origin behind that of anal.

Pelvic fins united to each other and to the abdomen by a thin membrane. A genital sheath of scales about the bases of the first few anal rays of the female. Preorbital relatively wide and armed with many irregular rows of very closely imbricated ctenoid scales.

Premaxillaries not expanded; they are protractile and strongly joined, the posterior processes fairly long. Dentaries firmly joined. Teeth in both upper and lower jaws conical, in many rows, the outer ones slightly enlarged and situated on the lips outside the mouth. Vomerine teeth and pseudobranchiae absent. Near its widened distal end, the maxillary is loosely connected to the outer skin of the preorbital, allowing considerable freedom of movement. Vertebrae, counting hypural, 40 or 41. Haemal arches expanded for the extension of the coelom and the large air bladder into the caudal region as far as the twenty-fourth vertebra. Hypocoracoid very large, vertically expanded; actinosts set high on the arch, half on the hypocoracoid and half on the hypercoracoid. Flange of the cleithrum extending far upward to upper end of pectoral arch.

The peculiar atherinid-like habitus and color of this fish sets it off as one of the most interesting specializations of the cyprinodonts. Evidently these little fishes have the same habits in the sealike expanse of Tanganyika as have the atherines in the ocean.

### Subfamily FUNDULINAE

#### APLOCHEILICHTHYS PUMILUS (Boulenger)

There are 48 specimens, U.S.N.M. no. 84158, of a small *Aplocheilichthys*, the largest 25 mm in standard length, which are placed under this name with strong doubt. They are labeled Nyanga, Lake Tanganyika.

I think there is a distinct probability that some confusion has occurred in Boulenger's placement of the Victoria and Tanganyika specimens of this genus (Boulenger, 1915, pp. 45-46). *Aplocheilichthys dhonti* (Boulenger, 1919, p. 17) is certainly different from what he calls *pumilus*, chiefly because of the different dorsal and anal fin contours, distinctly noticeable in the specimens of *dhonti* I have seen. I have examined three specimens labeled *H. pumilus* from Boulenger's material. One of them (U.S.N.M. no. 94327) from the Lufuko River (collector, Stappers) has a long peduncle and the middle dorsal and anal rays longest; I believe it represents *A. dhonti* or a related form. The second (U.S.N.M. no. 86643) is from the Lukuga River (collector, Dhont), and the third (U.S.N.M. no. 94297) is one of Degen's specimens from Entebbe, Lake Victoria; both of these have a deep peduncle and the posterior dorsal and anal rays longest; they fall into Boulenger's *pumilus*. The 48 specimens of Raven's collection have the long posterior dorsal and anal rays of *pumilus*,

but they have a long peduncle, the depth entering the length 1.66 or more times. Further, they do not have the distinctly vertical lower jaw of the Entebbe and Lukuga fishes, and they are more slender and delicately formed. It is very likely that the Victoria and Tanganyika *pumilus* are different forms and that at least two Tanganyika species were included by Boulenger under *pumilus*, but in the absence of good material and a revision of the many species described recently by Ahl, I can do nothing toward straightening out the matter. If the Victoria and Tanganyika *pumilus* are different, the name *pumilus* must go with the latter, since the original description was based on Tanganyika fish, the Degen Victoria examples merely having been mentioned.

All the *pumilus*-like species have practically the same scale and fin counts, and their separation is therefore difficult without careful examination of specimens in very good condition. There is no justification for the continued use, by some authors, of the later, emended generic name *Haplochilichthys*.

### Family SERRANIDAE

#### LATES MICROLEPIS Boulenger

Two small specimens, U.S.N.M. no. 84132, 36 and 43 mm in standard length, from Ujiji, are referred to this species. They have a wide, very irregular, lateral band from eye to caudal peduncle, and a narrower, less well developed band above this. Otherwise the cheeks and sides are silvery; the membranes of the spinous dorsal and of the pelvics are blackish. There are 18 or 19 developed rakers on the entire first gill arch, and some rudiments at either end.

### Family CICHLIDAE

#### TILAPIA NILOTICA (Linnaeus)

There is a single specimen, U.S.N.M. no. 84130, 47 mm in standard length, from Kigoma.

#### LIMNOTILAPIA DARDENII (Boulenger)

Six small specimens, the largest 52 mm in standard length, are in the collection; three are from Ujiji (U.S.N.M. no. 84105) and three from Kigoma (U.S.N.M. no. 84104).

#### LOBOCHILOTES LABIATUS (Boulenger)

Two young specimens, U.S.N.M. no. 84119, 45 and 54 mm in standard length, from Ujiji. In appearance they are strikingly unlike the adult figured by Boulenger (1915, p. 280, fig. 191). Superficially, the

hypertrophy of the lips is not noticeable, but on close examination the lips show thickening, and the triangular points have just begun their development. The ground color is pale brownish, marked with 14 conspicuous, vertical, dark bands, the first through the eye and the last on the base of the caudal. Each bar that abuts on the dorsal or anal forms a basal spot on the fin. On the dorsal these basal spots are carried outward and anteriorly on the fin as a bar. Caudal faintly spotted. Pectorals plain. Pelvics with membrane faintly brownish. Dorsal fin lappets tipped with brown. Both specimens have dorsal XVIII-10, anal III-7, and lateral lines 12+14, while the lateral scales are 34 and 33.

**PERISSODUS GRACILIS, new species**

PLATE 1, B

*Holotype*.—U.S.N.M. no. 84123, 46 mm in standard length, from Kigoma, Lake Tanganyika; collected in February 1920 by H. C. Raven.

*Paratypes*.—U.S.N.M. no. 102111, two specimens, 48 and 55 mm in standard length; same locality data as holotype.

Since its description by Boulenger in 1898, the genus *Perissodus* has been known only through the single 100 mm type specimen of *P. microlepis* in the British Museum. The discovery of three examples in Mr. Raven's collection is therefore of great interest. These specimens differ markedly from Boulenger's description in a few points. In view of our lack of knowledge of specific variation in *P. microlepis*, I have hesitated to describe my examples as new, but the differences, though small, appear to be fairly constant in the three, and are similar in character to those that have been found to be of specific value in other Tanganyika cichlids.

*Diagnosis*.—Differs from *Perissodus microlepis* in having a greater number of gill rakers, smaller mouth, more slender form, more numerous soft anal and dorsal rays, 17 instead of 18 dorsal spines, slightly smaller scales, a different lateral line count, and longer pelvic fins. In the peculiar dentition, the thick lips, and most general characters, the species is similar to *P. microlepis*. The head length is proportionally about the same as in *P. microlepis*, and since these specimens are much smaller than the type of that species, it might be suspected that the proportional head length in adults of *gracilis* would be smaller than in Boulenger's species.

*Description*.—Depth of body somewhat over 4 in standard length, length of head 3.3 to 3.4. Head 2.3 times as long as broad; snout a little broader than long, a little longer than eye, which is 3.1 to 3.4 times in length of head and is equal to or longer than the bony interorbital. Lower jaw projecting maxillary extending barely to

below anterior margin of eye; 19 or 20 teeth in the upper jaw, 16 in the lower; 3 series of scales on cheek. Gill rakers rather long, 18 to 20 on lower limb of first arch, 5 to 7 on upper limb.

Dorsal XVII-11 or 12, spines increasing in length to the last. Anal III-9 to 11. Pectoral 13, two-thirds length of head. Pelvies I-5, reaching or surpassing the vent. Caudal with 8 principal rays above its middle and 8 below, its edge emarginate. Caudal peduncle about 1.66 times as long as deep.

Scales 67 to 70 to hypural joint. Lateral lines two in number, very distinct, 47 to 49 scales in upper and 23 to 27 in lower to hypural joint. Transverse scales between first scale of lateral line and base of first dorsal spine  $7\frac{1}{2}$ , between front part of lateral line and base of pelvies 17 or 18.

Color dull brownish, with traces of broad, dark, transverse bands showing only along the back, the first above the gill slit, the second over the last third of pectoral, the third above the vent, the fourth over the anal origin, the fifth over the middle of the anal, the sixth over end of anal, and the seventh on the caudal peduncle. A dark blotch at middle of caudal base.

*Counts and measurements in millimeters.*—(Under each item, the holotype is mentioned first.) Dorsal XVII-12, XVII-11, XVII-12. Anal III-11, III-9, III-10. Pectoral 13-13, 13-13, 13-13. Pelvic I-5, I-5, I-5. Caudal 16, 16, 16. Gill rakers on lower and upper limbs (counted on excised first arch of left side) 19+5, 18+6, 21+7. Lateral scales to hypural joint 70, 67, 69. Lateral lines (lower counted to hypural joint) 49+27, 48+23, 47+24. Transverse scales (origin lateral line to first dorsal spine, and forward part lateral line to pelvic origin)  $7\frac{1}{2}/18$ ,  $7\frac{1}{2}/17$ ,  $7\frac{1}{2}/18$ . Standard length 46, 48, 55. Depth 10.5, 11.5, 13. Head 14, 14.5, 16.5. Eye 4.5, 4.5, 4.5. Bony interorbital 3.5, 3.5, 4.5. Length caudal peduncle 9.5, 9, 10.5. Least depth caudal peduncle 4.5, 5, 6. Snout tip to maxillary end 5, 6, 6. Lower jaw 4.5, 5, 5.

**HAPLOCHROMIS HOREI (Günther)**

We have eight specimens, U.S.N.M. no. 84127, the largest 63 mm in standard length, from Ujiji. They have the typical long snout, spotted fins, and barred body of this species. Sometimes there is a single longitudinal band, sometimes two or three. The dark spot at the upper posterior corner of the opercle is plain in all, but the oblique streak at the junction of the interopercle and subopercle and the spotting of the forehead are occasionally faint. Article 19 of the International Rules requires that the original orthography of the specific name be retained.

**CALLOCHROMIS PLEUROSPILUS (Boulenger)**

The genus *Callochromis* Regan is composed of four species described by Boulenger (1915, pp. 421-425). The 41 examples recorded below are smaller than most of Boulenger's but are large enough (average about 40 mm in standard length) for comparison. I have, however, experienced great difficulty in their determination and have come to the conclusion that Boulenger's arrangement must be amended. Either some of the species must be synonymized or more than four recognized.

The 41 specimens, U.S.N.M. nos. 84117 and 84125, are all from Ujiji. On no character can I separate them into more than one form, yet different examples would fall into *C. rhodostigma* and *C. pleurospilus*. The variation in the extent of the mouth is considerable, some having the maxillary reaching slightly behind the front of the eye, while in others it does not nearly reach below the eye. There is every gradation between. The soft anal rays vary from 5 to 7 in number (normally 7), and the teeth in the outer row in the upper jaw vary from 46 to over 60. Scales between the beginning of the lateral line series and the dorsal origin  $4\frac{1}{2}$  in most and  $3\frac{1}{2}$  in a few.

It is possible that in *Callochromis* we have one of those genera in which the species are most easily determined by the coloration of the fresh specimens, but much of the color of my examples is gone. All have a prominent dark opercular spot, dark tipped dorsal lappets, and some indication of an indistinct row or connected series of median lateral spots. In this they seem to agree with Boulenger's figures (Boulenger, 1906, pl. 39, fig. 2 and 2a).

**CALLOCHROMIS MACROPS (Boulenger)**

One small example, U.S.N.M. no. 102081, 29 mm in standard length, was separated from the lot of *C. pleurospilus* from Ujiji because of its obviously different physiognomy, greater depth, more compressed body, wider interorbital, different color, and its longer and more numerous dorsal spines (dorsal XVI-12). In color the lateral spots appear inclined to form a trace of faint, wide vertical bands, which alternate with dark areas along the base of the dorsal fin. I place the specimen here because of its great resemblance to Boulenger's original figure of one of the types of *macrops* (Boulenger, 1898, pl. 3, fig. 2). After examining this fish and the series of *pleurospilus*, I am inclined to doubt the specific identity of *Pelmatochromis melanostigma* (Boulenger, 1906, p. 567, pl. 38, fig. 1) with the figured type of *macrops*, in spite of the smaller size of the latter.

## SIMOCHROMIS BABAULTI Pellegrin

*Simochromis babaulli* PELLEGRIN, 1927, p. 500 (Ouvira, Lake Tanganyika); 1928, p. 82, fig. 1 (figure of type).

Four specimens, U.S.N.M. no. 84129, the largest 61 mm in standard length, are from Kigoma; one has been partially skeletonized, and another has been presented to the British Museum.

This species has hitherto been known from a single specimen of approximately the same size as our largest one. The four examples show the following counts: Dorsal XVI-9; XVI-9; XVII-9; XVI-9. Anal III-8; III-8; III-7; III-7. Pectoral 16 in all four. Lateral lines 21+10, 21+12, 22+11, 21+12. Lateral scales 29, 30, 29, 30. Gill rakers on upper and lower limbs of first arch 3+7 in all four. Bicuspid teeth in first row in upper jaw 25, 29, 28, 24. Caudal truncated. Head about 3 in standard length.

There are 8 or 9 rather wide, vertical, dark bands on a lighter background. Head rather dark, lightening on opercles, on throat, and on breast. Base of pectoral rather dark. Fins nearly plain except for a dark longitudinal streak through the membranes of the first six dorsal spines in one example and a faint darkening of the lappets at the fin edge.

An interesting problem has arisen concerning the systematic position of this fish. In his review of the Tanganyika genera, Regan (1920a, p. 35) places *Simochromis* in the *Tilapia* group, which is characterized by the exclusion of the basioccipital from the articular surface of the upper pharyngeal apophysis. In examining the dentition of *S. babaulli* I was struck with its remarkable similarity to that of the Nyasa *Pseudotropheus tropheops* (Regan, 1921, p. 681, fig. 2a). This had, indeed, already been noted by Pellegrin. Further, *S. babaulli* has much of the appearance of *P. tropheops*, but *Pseudotropheus* is a member of the *Haplochromis* group, in which the basioccipital enters the facet of the upper pharyngeal apophysis. Examination of a cranium of *S. babaulli* was not wholly satisfactory, owing to the small size of the specimen and my unfamiliarity with the group.

Dr. Ethelwynn Trewavas, of the British Museum, has been so kind as to examine this cranium of *S. babaulli* (as well as a complete specimen) in the light of her extensive knowledge of the African Cichlidae. She writes:

I agree with you that the pharyngeal apophysis is not of the *Tilapia* type; neither is it of the typical *Haplochromis* type. It is a young fish with the pharyngeal apophysis very weakly developed, but it is possible to see that the basioccipital does not contribute to the facets for the pharyngeal. Nevertheless it (the basioccipital) extends forward so as to meet the protic at the antero-lateral side of the facet, and the suture between parasphenoid and basi-



occipital forms the postero-lateral edge of the facet. This is unlike *Tilapia* in which the meeting of prootic and basioccipital is at the postero-lateral side of the apophysis, and the basioccipital not only takes no share in the facet, but also none in the apophysis.

Comparison of this cranium with that of a young *Simochromis diagramma* shows a very close agreement between the two. Moreover, in the skeleton of an adult *S. diagramma* the postero-lateral corner of each facet is formed by the basioccipital. It seems therefore that *Simochromis* belongs to the *Haplochromis*-group and not to the *Tilapia*-group, and the possibility of a very close relationship with *Pseudotropheus* will have to be considered. Meanwhile this species, *S. babaulti*, although it so closely resembles *Pseudotropheus trophocops*, is more like *Simochromis diagramma* in its pharyngeal dentition and in the depth of the preorbital, and is correctly assigned to this genus.

I defer to Dr. Trewavas' opinion in regard to the generic position of *S. babaulti*, but I wish to point out that if Boulenger's figure of the dentition of *S. diagramma* (Boulenger, 1915, p. 275, fig. 187) can be relied on, *S. babaulti* differs considerably. Boulenger figures the inner rows of small teeth in the upper jaw as running back behind the enlarged conical lateral teeth and shows the posterior projections of the lower dentition as composed of several rows. In *S. babaulti*, on the contrary, there are three rather even rows of small tricuspid teeth behind the main outer row of bicuspid ones in the front of the upper jaw, but the small inner teeth are not continued backward behind the lateral enlarged conical ones. Further, the posterior prolongations of the lower dental patch are formed on each side of the lower jaw by a single regular row of conical teeth. In this, *S. babaulti* is practically identical with *Pseudotropheus* and differs distinctly from Boulenger's figure of *S. diagramma*.

The difference between *Simochromis* and *Pseudotropheus* is certainly very slight, and it may be that the genera will have to be merged, unless hitherto unknown characters are employed. This brings up the question of the autochthonous nature of certain of the Tanganyika and Nyasa genera. If *Simochromis* and *Pseudotropheus* are indeed convergent rather than identical stocks, the parallelism is astounding.

Four very small specimens, U.S.N.M. no. 84118, 15 to 34.5 mm in standard length, from Ujiji, are placed here with great hesitancy. They have the posterior extensions of the dentition uniserial, but in conical lateral teeth of the upper jaw are little developed. They have the rounded snout of *S. babaulti* and the same general form, but the body is slenderer (about 3.5 in the largest example) and the head is shorter (3.3 in the largest). The counts of the two largest ones are: Dorsal XVII-9 and XVI-8, anal III-7 in both, lateral lines 23+9 and 22+10, and lateral scales 30 and 32. These examples

may well be a new form close to *S. babaulti*, or perhaps the young of *S. diagramma*; they are certainly not any other cichlid yet reported from Tanganyika.

STAPPERSIA SINGULARIS Boulenger

One specimen, U.S.N.M. no. 81110, 40 mm in standard length, was collected at Kigoma. Dorsal XIV-13. Anal III-10. Lateral scales to end hypural fan 37. Upper lateral line 26, lower 11. Gill rakers 9 blunt, rounded knobs on lower limb of first arch, and one short, slender raker on upper limb between the angle and the superior fleshy lobe. Color pale brownish. This example agrees in most characters with the accounts of Boulenger (1915, p. 450, and 1920, p. 53) and of Regan (1920a, p. 47), but the low soft anal count is notable.

Besides the two types described by Boulenger, I find only one other record of the capture of this rare fish (Pellegrin, 1927, p. 500).<sup>1</sup> The elongate inner pelvic rays form a notable modification shared, among cichlids, only with two other genera, *Xenotilapia* and *Enantiopus*, both also from Tanganyika.

TELMATOCHROMIS TEMPORALIS Boulenger

Seven specimens, U.S.N.M. no. 84126, 26.5 to 50 mm in standard length, are from Kigoma; one of these is now in the British Museum. The other six show the following counts (given in decreasing order of size of examples): Dorsal XXII-7, XXII-7, XX-7, XX-7, XX-7, XX-7. Anal VI-6, VI-6, V-7, VI-6, VI-6, V-6. Lateral lines 25+2, 23+5, 26+6, 24+5, 22+4, 22+3. Lateral scales 34, 33, 36, 33, 33, 33.

Dr. Trewavas has been so kind as to compare one of the Kigoma fish with the types and other specimens of *T. temporalis* in the British Museum. She remarks that my fish has a smaller mouth than any in the British Museum. At my request she also examined the teeth of the types and finds that the lateral teeth of the jaws are all unicuspid, but that in one young example the one or two lateral teeth immediately behind the enlarged ones have vestigial cusps. In the Kigoma specimens, on the contrary, I find the six or seven teeth behind the enlarged ones to be tricuspid, and the ones posterior to these unicuspid.

The tricuspid lateral teeth, the smaller mouth, and the lower scale count might be taken to indicate a species distinct from *T.*

<sup>1</sup> Since this was written, Borodin (1936), in a paper marred by much misspelling and many evident egregious errors of generic and specific placement, has recorded 26 specimens from Ujiji. Until they are re-examined by a competent ichthyologist, I question the identification of these specimens.

*temporalis*, but I can not believe this to be the case, for several reasons. My specimens all show the typical coloration as figured by Boulenger, the temporal band, the dark basal pectoral bar, the mottled fins, and the plain brownish body color, although they all have, in addition, a small, more or less distinct dark spot in the middle of the caudal base. As for the difference in the lateral scale count, I believe this to be due to the fact that Boulenger counted some scales out beyond the hypural on the caudal base. In the six specimens before me, the size of the mouth and the shape of the head vary greatly. In the largest and the two smallest the maxillary reaches about midway between the nostril and the eye; these also have a less declivous snout profile. In the other three the snout profile is more declivous and rounded and the maxillary reaches variously almost to, just to, or slightly behind the anterior part of the eye. The tricuspid lateral teeth form a difference of some weight. However, the characters of *T. temporalis* have been known only through eight or nine examples taken at relatively few localities. I feel that when this and other species are known through large samples from an adequate number of localities, it will be found that dental and other variations will be somewhat greater than now suspected.

**TELMATOCHROMIS BIFRENATUS, new species**

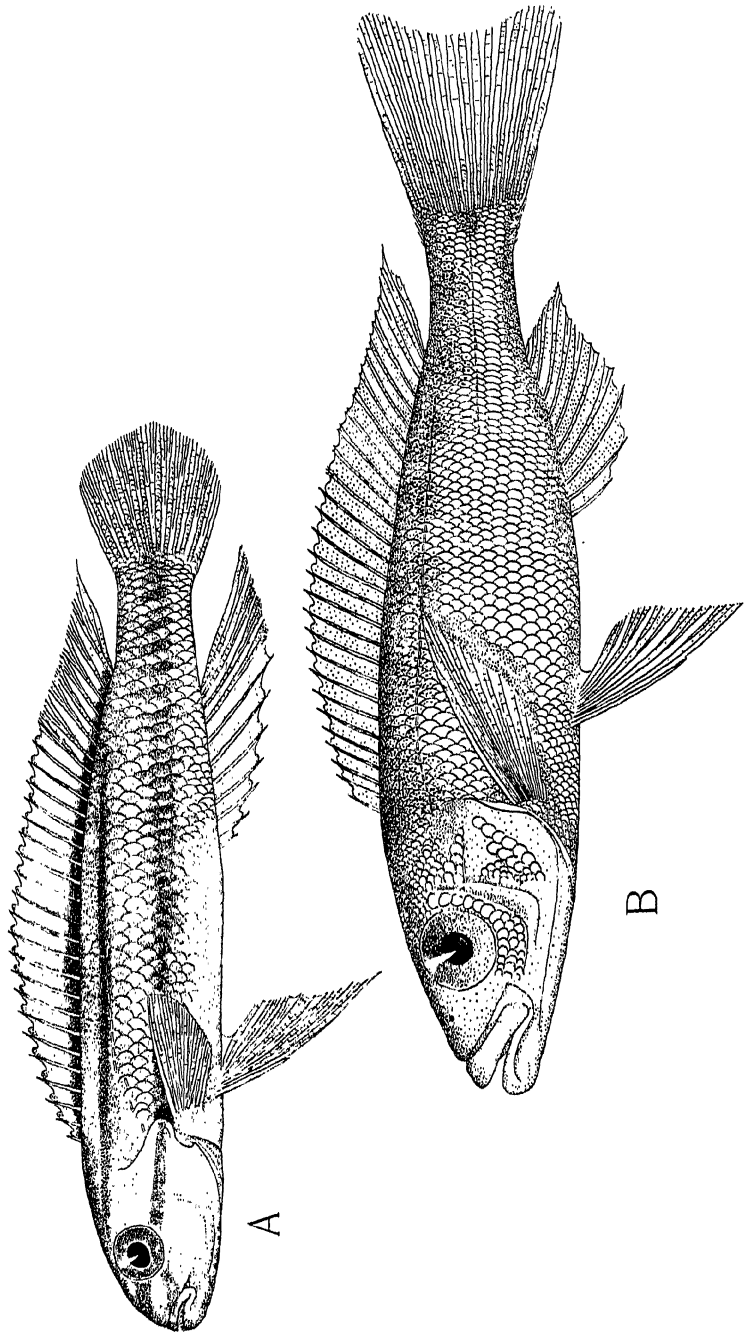
PLATE 1, A

*Holotype*.—U.S.N.M. no. 84121, 40 mm in standard length, from Kigoma, Lake Tanganyika; collected in February 1920 by H. C. Raven.

*Paratype*.—U.S.N.M. no. 102112, same size and locality as holotype.

Only two species of this genus, first described by Boulenger, are certainly known, although three forms of uncertain generic position described by Steindachner (1909, pp. 400-404) in the genus *Julidochromis* have to be considered. The present new form differs widely, however, from each of Steindachner's unfigured species in one or more important characters of squamation, fin count, body proportions, or color. Further, it cannot be *Julidochromis macrolepis* Borodin (1931, p. 51; 1936, p. 21, pl. 1, fig. 5), which, from the wretched figure, looks to me, as it did to Regan (1932, p. 28), like a *Lamprologus*.

*Diagnosis*.—Closely allied to *T. vittatus* Boulenger, but differing distinctly in having a more elongate body, a longer head, a longer and less bluntly rounded snout, a larger and less inferior mouth, a lower lateral scale count, a longer and more slender caudal peduncle, and two lateral dark bands on the body instead of one.



A, *Tetmalochromis bifrenatus*, new species: Holotype; B, *Perissodus gracilis*, new species: Holotype. Both figures are inaccurate in certain details; where the figure and description disagree, the description is to be taken as correct.



*Description*.—Depth of body 5 in standard length, length of head 3.6. Head 2.56 times as long as broad; profile of snout descending in a strong curve, but much less bluntly rounded than in *T. vittatus*; snout longer than eye, which is 3.66 in length of head and nearly a third larger than interorbital width; mouth larger than in *T. vittatus* but not reaching to below eye. Front row of teeth of each jaw composed of 8 to 10 enlarged, conical, and very slightly flattened teeth. Backing these is a crowded band of four or five very irregular rows of small tricuspid teeth. The posterior extensions of both the upper and lower dentition form a single row of very small teeth, which become progressively smaller and lose the two outer cusps toward the end of the row. Gill rakers 5 or 6 very short, stubby points, at and just before the angle of the upper and lower limbs of the first gill arch.

Dorsal XXI or XXII-8, spines increasing in length to the last, which is not half the head length. Anal VII-5 or 6, the last spine longer than last dorsal. Pectoral rather short, about as long as head without opercle. Pelvics I-5, the first soft ray produced, reaching anus. Caudal rounded, with 7 branched rays above middle and 7 below. Caudal peduncle 1.5 times as long as deep.

Scales 36 to 38 to hypural joint. Lateral lines two, the upper very irregular, with 26 scales, the lower with 6 or 7. Cheeks, opercles, and nape as far as dorsal origin naked, as well as a strip between the scales along the dorsal base and the lateral line, as far back as the fifth or sixth dorsal spine. Body scales rather irregular in size and arrangement, large on peduncle and middle of sides, growing smaller and crowded above upper lateral line and on belly. Dorsal and anal naked, caudal finely scaled nearly to its end.

Ground color yellowish brown. Nape and forehead irregularly mottled with dark brown. A dark-brown band down midline of back, involving the base of the dorsal fin but not extending on the peduncle or nape. Another brown longitudinal line extends from above eye along upper part of sides, fading out under end of spinous dorsal fin. A third dark-brown line extends from lower third of eye back through the elongate opercular point, above the pelvic base, and along the sides just below the midline, finally fading at caudal base; at the pectoral, this line involves an intense dark spot (but not a bar) above the fin base, and on the posterior half of the side it widens and breaks up into irregular, vertical, oblique patches. On the snout an irregular, mottled pattern forms a line extending forward from each eye and meeting in front; another dark bar connects the lower part of each eye with the mouth. Pectorals and pelvics plain. Caudal faintly dusky. Lappets of spinous dorsal tipped with dark. A narrow dark edging along entire border of anal; this may be faint or strong.

*Counts and measurements in millimeters of holotype.*—(Figures in parentheses refer to the paratype.) Dorsal XXI-8 (XXII-8). Anal VII-5 (VII-6). Lateral scales to hypural end 36 (38). Lateral lines 26+6 (26+7). Standard length 10 (40). Total length 47 (48). Depth 8. Head length 11. Head width 4.3. Eye 3. Interorbital 1.9. Snout 3.7. Least depth peduncle 4. Length peduncle (from anal fin) 6.

**LAMPROLOGUS MODESTUS Boulenger**

One small example, U.S.N.M. no. 84122, from Kigoma, 32 mm in standard length, appears to belong to this species. It has a larger eye and shorter snout than my examples of *L. mondabu*. The lateral scales to end of hypural fan are 35, while the upper lateral line count is 25, the lower 7. The depth is about 3.6 in the standard length and the caudal appears to be truncate. There are 9 rakers, the first very short, on the lower limb of the first gill arch. Dorsal XIX-9. Anal V-6.

**LAMPROLOGUS MONDABU Boulenger**

Four examples of this long-snouted species, U.S.N.M. no. 84128, from Kigoma, 60 to 80 mm in standard length, agree admirably with Boulenger's description and figure, which were based on two specimens from Kaboge. My count of the dorsal is XIX-9, and of the anal V-6 or 7. Scales from upper end of gill opening to end of hypural fan 36 to 40. These scale counts are lower than Boulenger's but agree with his figure. Caudal distinctly emarginate.

**LAMPROLOGUS RETICULATUS Boulenger**

Two small specimens, U.S.N.M. no. 102113, from Kigoma, 31 and 40 mm in standard length, show the dark, reticulated pattern of this species. The caudal is truncated. Dorsal XIX-9. Anal VIII-8. Lateral scales to end hypural 36 to 37. Upper lateral line 21 or 22 (indistinct or interrupted near end); lower short, 6 or 7. I can count only 13 rakers on lower part of first gill arch. These specimens have the elongate form of the type and only known example of *L. reticulatus* and are in no way similar to *L. calliurus* Boulenger or *L. finalimus* Nichols and La Monte (1931, p. 1).

**LITERATURE CITED**

BORODIN, NIKOLAI.

1931. Some new cichlid fishes from Lakes Victoria and Tanganyika, central Africa. Proc. New England Zool. Club, vol. 12, pp. 49-54

1936. On a collection of freshwater fishes from Lakes Nyasa, Tanganyika, and Viktoria in central Africa. Zool. Jahrb. (Abt. Syst.), vol. 68, no. 1, pp. 1-34, 1 pl.

## BOULENGER, GEORGE ALBERT.

1898. Report on the collection of fishes made by Mr. J. E. S. Moore in Lake Tanganyika during his expedition, 1895-96. Trans. Zool. Soc. London, vol. 15, pt. 1, no. 1, pp. 1-30, 8 pls.
1906. Fourth contribution to the ichthyology of Lake Tanganyika. Report on the collection of fishes made by Dr. W. A. Cunningham during the Third Tanganyika Expedition, 1904-1905. Trans. Zool. Soc. London, vol. 17, pt. 6, no. 1, pp. 537-600, 12 pls.
1915. Catalogue of the fresh-water fishes of Africa in the British Museum, vol. 3. London.
1919. On a collection of fishes from Lake Tanganyika, with descriptions of three new species. Proc. Zool. Soc. London, 1919, pp. 17-20.
1920. Poissons de la Mission Stappers, 1911-1913, pour l'exploration hydrographique et biologique des lacs Tanganika et Moëro. Rev. Zool. Africaine, vol. 8, fasc. 1, pp. 1-57.

## FOWLER, HENRY WEED.

1910. Notes on fishes of the orders Haplomi and Microcyprini. Proc. Acad. Nat. Sci. Philadelphia, vol. 68, pp. 415-439.

## HIERRE, ALBERT WILLIAM.

1924. Distribution of the true fresh-water fishes in the Philippines. I. The Philippine Cyprinidae. Philippine Journ. Sci., vol. 24, no. 3, pp. 249-306, 2 pls.
1933. The fishes of Lake Lanao: a problem in evolution. Amer. Nat., vol. 67, pp. 154-162.

## MYERS, GEORGE SPRAGUE.

1931. The primary groups of oviparous cyprinodont fishes. Stanford Univ. Publ., Univ. Ser., Biol. Sci., vol. 6, no. 3, pp. 243-254.

## NICHOLS, JOHN THOMAS, and LA MONTE, FRANCESCA.

1931. A new *Lampuloxys* from Lake Tanganyika. Amer. Mus. Nov., no. 478, 2 pp.

## PELLEGRIN, JACQUES.

1927. Mission Guy Babault. Poissons du lac Tanganyika. Bull. Mus. Hist. Nat., 1927, pp. 499-501.
1928. Mission Guy Babault. Poissons de la région des lacs Kivu et Edouard. Bull. Mus. Hist. Nat., 1928, pp. 82-86.

## REGAN, CHARLES TATE.

- 1920a. The classification of the fishes of the family Cichlidae. I. The Tanganyika genera. Ann. Mag. Nat. Hist., ser. 9, vol. 5, pp. 33-53.
- 1920b. A revision of the African cichlid fishes of the genus *Tylochromis*. Ann. Mag. Nat. Hist., ser. 9, vol. 5, pp. 163-169.
1921. The cichlid fishes of Lake Nyassa. Proc. Zool. Soc. London, 1921, pp. 675-727, 6 pls.
1922. The cichlid fishes of Lake Victoria. Proc. Zool. Soc. London, 1922, pp. 157-191, 4 pls.
1932. The cichlid fishes described by Borodin from Lakes Tanganyika and Victoria. Proc. New England Zool. Club, vol. 13, pp. 27-29.

## STENDACINER, FRANZ.

1909. Ueber einige neue Fischarten aus dem Tanganyikasee . . . sowie über *Caenotropus punctatus* M. Tr. nach Exemplaren aus Surinam. Anz. Akad. Wiss. Wien, vol. 46, pp. 399-404.

## TREWAVAS, ETHELWYNN.

1935. A synopsis of the cichlid fishes of Lake Nyasa. Ann. Mag. Nat. Hist., ser. 10, vol. 16, pp. 65-118.







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## THE ICHINEUMON-FLIES OF THE GENUS BRACHYCYRTUS KRIECHBAUMER

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ONLY four species have heretofore been referred to the genus *Brachycyrtus* Kriechbaumer, only three I believe properly so. The fourth, *Brachycyrtus* (sic!) *aporiae* (Matsumura MS.) Okamoto,<sup>1</sup> described in Japanese, appears to be a *Hemiteles* and to have been redescribed as *Hemiteles aporiae* by Uchida.<sup>2</sup> The three species properly referred to the genus are the European *ornatus* Kriechbaumer, the Japanese *Proterocryptus nawaii* Ashmead, transferred to *Brachycyrtus* by Roman, and the Australian *australis* Roman.

In the three new species described herein the genus is introduced for the first time as American. Apparently the genus is essentially tropical and, as the fauna of the Tropics becomes better known, will perhaps be found to be rich in species.

Exclusive of the genotype, *ornatus* Kriechbaumer, which I have not seen, the genus is divisible into three well-defined groups. The characters distinguishing these groups are not, I believe, of generic significance, although they are much more conspicuous than many characters that are universally recognized as of generic status. Such characters appear in many tropical genera and even in tropical species of genera occurring in the Temperate Zone.

<sup>1</sup> Hokkaido Agr. Exp. Sta., Sapporo, Japan, Rep. 12, p. 65, 1921.

<sup>2</sup> Journ. Fac. Agr. Hokkaido Imp. Univ., vol. 25, p. 343, 1930.

Heretofore nothing has been known of the host relations. A specimen of *nawaii* from the Philippine Islands, however, was reared as a parasite of *Chrysopa*, and it appears reasonable to suppose that *Chrysopa* is the normal host of the genus, since in general form of head and thorax the species are similar to the species of *Chrysopoctonus*.

### Genus BRACHYCYRTUS Kriechbaumer

*Brachycyrtus* KRIECHBAUMER, Corresp. Blatt zool.-min. Ver. Regensburg, vol. 34, p. 161, 1880. (Genotype, *Brachycyrtus ornatus* Kriechbaumer.)

*Proterocryptus* ASHMEAD, Proc. U. S. Nat. Mus., vol. 30, p. 174, 1906. (Genotype, *Proterocryptus nawaii* Ashmead.)

#### KEY TO SPECIES OF BRACHYCYRTUS

1. Malar space much reduced; occipital carina extending straight to base of mandible; epomia absent or distinct at most below; scutellum margined to apex, its fovea not limited anteriorly by a sharp carina, not foveolate; nervulus postfurcal by more than its length (American species)----- 2
 

Malar space nearly or quite as long as basal width of mandible; occipital carina inflexed below and joining hypostomal carina; epomia strong and complete; scutellum margined only at base, its fovea limited anteriorly by a sharp carina, strongly foveolate; nervulus postfurcal by less than its length (Old World species)----- 4
2. Eyes deeply emarginate opposite antennae; epomia developed below; scutellar fovea narrow and deep; propodeum completely areolated, minutely punctate and densely clothed with white pubescence; second tergite with distinct elongate gastrocoeli; thorax largely ferruginous (Florida)----- pretiosus, new species
 

Eyes barely emarginate; epomia absent; scutellar fovea broad and shallow; propodeum uniformly shagreened, entirely without pubescence, incompletely areolated, lateral carina largely absent; second tergite without trace of gastrocoeli; body yellow with black markings----- 3
3. Eyes distinctly convergent below; face broader than long; propodeum with all apical areas defined (Panama)--- convergens, new species
 

Eyes nearly parallel; face fully as long as broad; propodeum without apical pleural areas (Panama)----- oculatus, new species
4. Discocubitus subangulate; abscissula nearly half as long as intercubitella; abdomen black with tergites margined with yellow (Japan; Philippine Islands)----- nawaii (Ashmead)
 

Discocubitus arcuate; abscissula about one-fourth as long as intercubitella; abdomen rufous with tergites more or less blackish basally and white apically (Australia)----- australis Roman

The genotype, *ornatus* Kriechbaumer, is not included in the key because none of the group characters of the first couplet is mentioned in any description that I have seen. The species, however, is distinct from all others in its generally black body with much less extensive yellow markings.

*BRACHYCYRTUS PRETIOSUS*, new species

FIGURE 1

This species is the only known representative of a group that, in its deeply emarginate eyes, deep scutellar fovea, and completely areolated propodeum, is more similar to the Old World group than to the other American group; but from the former it is amply distinct by the characters of the first couplet of the foregoing key.

*Female*.—Length 6.0 mm; antenna 4.5 mm; ovipositor sheath 1.0 mm.

Head polished, from above distinctly less than half as thick as broad; temples almost perpendicular, weakly convex; ocellar triangle weakly transverse; head in front view slightly broader than long, eyes together comprising almost exactly two-thirds of its total width; eyes very deeply, subtriangularly emarginate; face parallel-sided, as long as broad, distinctly narrower than frons, in profile strongly convex, weakly and sparsely punctate; clypeus nearly twice as broad as long, narrowly truncate at apex; malar space barely half basal

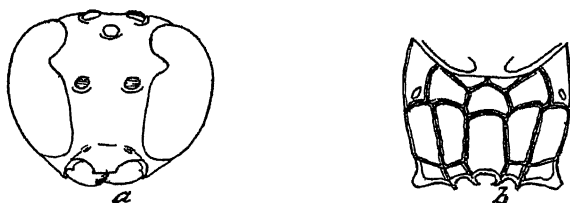


FIGURE 1.—*Brachycyrtus pretiosus*, new species: a, Head; b, propodeum.

width of mandible; occipital carina straight below and joining hypostomal carina immediately behind base of mandible; antennae 29-jointed, basal joint of flagellum hardly four times as long as thick, not nearly twice as long as second, subapical joints twice as thick as first joint.

Thorax as deep as long, polished, mesoscutum and propodeum obscurely punctate, scutellum more distinctly so; epomia developed in lower half; prepectal carina extending about halfway up anterior margin of mesopleurum; mesopleural scrobe diverging only slightly from posterior margin; notauli entirely absent; scutellum broader than long, weakly convex, margined to apex, its fovea very deep and narrow but not limited anteriorly by a distinct carina; propodeum densely clothed with rather long white pubescence, completely areolated, areola as broad as long, rounded anteriorly, costulae not far before apex. Intercubitus more than half as long as space between it and second recurrent; nervulus postfurcal by a little more than its length; abscissula fully three-fourths as long as intercubitella.

Abdomen shining, finely punctate and with short white pubescence; first tergite virtually glabrous and sparsely punctate; second tergite nearly as long as first, fully three times as long as broad at base, with distinct elongate oblique gastrocoeli; spiracles distinctly behind middle, tergites 2-6 with broad transparent epipleura; ovipositor sheath about as long as first tergite.

Head and abdomen black and yellow, thorax largely ferruginous; yellow markings as follows: Broad complete orbital rings, face, clypeus, mandibles, palpi, underside of scape, and pedicel; broad anterior and humeral margins of pronotum, triangular spots in positions of notauli, scutellum, and postscutellum; broad subapical bands on tergites 1-6, those on 4-6 divided medially, apical lateral margin of tergite 7, and entire venter. Flagellum blackish above, ferruginous below. Legs whitish with black or piceous markings as follows: On middle femur an elongate spot on each side above toward apex; on hind leg large spots on inner and outer sides of coxa below, basal joint of trochanter, elongate spots on outer and inner sides of femur, base and apex of tibia with a connecting stripe on outer side, and apices of the tarsal joints. Wings hyaline with fuscous venation.

*Male*.—Essentially like female, but the face broader, malar space longer, seventh tergite black with a small yellow spot on each side.

*Type locality*.—Hillsboro County, Fla.

*Other localities*.—Osceola County, Lake County, and Pinellas County, Fla.

*Type*.—U.S.N.M. no. 50623.

Three females and three males, all taken in bait traps in connection with the Florida Fruit Fly Survey of 1929-30. One of the males is headless, and another lacks all the abdomen except the first segment.

#### BRACHYCYRTUS CONVERGENS, new species

FIGURE 2

This and the next following species form a group differing from both of the other groups in the barely emarginate eyes; entire lack of epomia; broad, shallow, and smooth scutellar fovea; virtually absent lateral carinae of propodeum; uniformly shagreened propodeum; and entire lack of gastrocoeli.

*Female*.—Length 6.0 mm; antenna 5.0 mm; ovipositor sheath 1.0 mm.

Head polished, nearly half as thick as broad, temples oblique, very weakly convex; ocellar triangle moderately transverse, the postocellar line fully twice as long as lateral ocellar line, a short deep groove between the posterior ocelli; head in front view distinctly transversely oval, the eyes together comprising distinctly less than two-

thirds total width; eyes very weakly emarginate, distinctly convergent below; face distinctly broader than long, sparsely and finely punctate, in profile strongly convex; clypeus twice as broad as long, truncate at apex; malar space about half as long as basal width of mandible; occipital carina extending straight to base of mandible; antennae 33-jointed, basal joint of flagellum about five times as long as thick and nearly twice as long as second, subapical joints much less than twice as thick as first.

Thorax slightly deeper than long, polished, mesoscutum and scutellum very sparsely and finely punctate, propodeum very uniformly and finely shagreened and subopaque; epomia entirely absent; prepectal carina ascending about halfway up anterior margin of mesopleurum and ventrally approaching very closely the posterior carina of the sternum; mesopleural scrobe very strongly oblique; notauli represented anteriorly by small shallow pits; scutellum as broad as long, moderately convex, margined to apex, its fovea shallow,

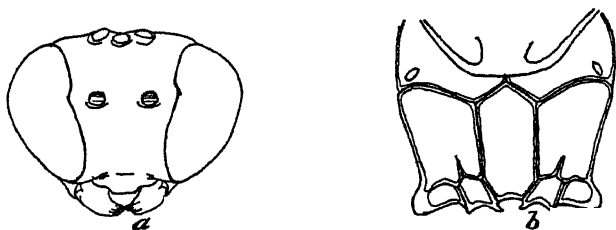


FIGURE 2.—*Brachycyrtus convergens*, new species: a, Head; b, propodeum.

smooth, not limited anteriorly by a carina; propodeum incompletely areolated, the lateral carinae lacking except at apex and the areola and petiolar area confluent, parallel-sided posteriorly, acutely pointed basally, all five apical areas defined. Intercubitus more than half as long as space between it and recurrent; nervulus postfurcal by much more than its length; abscissula nearly half as long as intercubittella.

Abdomen polished, with sparse minute punctation and pubescence, first tergite virtually impunctate and glabrous; postpetiole much broader than petiole; second tergite distinctly shorter than first and little more than twice as long as broad at base, without trace of gastrocoeli, spiracles distinctly behind middle; tergites 2-6 with broad, transparent epipleura; ovipositor sheath as long as first segment.

Head and thorax yellow with black markings as follows: Occiput and posterior margin of vertex and temples, narrowly joined to a triangular spot enclosing the ocelli; a medium stripe in anterior two-thirds of mesoscutum and a U-shaped mark with its base in

the scutellar fovea and its arms extending forward on the lateral lobes and narrowly confluent medially with a pyriform spot on scutellum; a small spot on postscutellum; a large spot on each side of propodeum at base; tegulae; an oblique band in the mesopleural scrobe, a small spot in prepectus, and the entire sternum and lower pleurum; abdomen black, the tergites broadly yellow at apex, venter entirely yellow. Scape and pedicel black above, yellow below; flagellum fuscous, paler at base and below, flagellar joints 18-22 yellow; legs yellow; front and middle femora each with a piceous stripe above, middle tibia with a more or less distinct dorsal stripe; hind coxa black at base above and below, and with a dash of black on the outer side at apex; basal joint of trochanter black; femur with a piceous stripe on either side, tibia blackish with a broad yellow annulus at middle, calcaria yellow, tarsus fuscous except basal half of first joint; wings hyaline, venation blackish.

*Type locality*.—Cano Saddle, Gatun Lake, Panama.

*Type*.—U.S.N.M. no. 50624.

One female taken by R. C. Shannon, May 8, 1923.

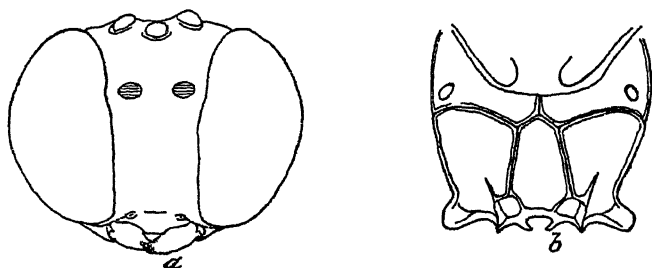


FIGURE 3.—*Brachycyrtus oculatus*, new species: a, Head; b, propodeum.

**BRACHYCYRTUS OCULATUS, new species**

FIGURE 3

Superficially very similar to *convergens*, with which it agrees almost exactly in color pattern; but remarkably distinct from that species in the form and detail characters of the head.

*Female*.—Length 7.0 mm; antenna 7.0 mm; ovipositor sheath 1.5 mm. Differs from the above description of *convergens* only as follows: Head not so thick, temples virtually flat and less strongly oblique; ocellar triangle more strongly transverse, the postocellar line about three times as long as lateral ocellar line; head in front view very strongly transversely oval, the eyes very large and comprising distinctly more than two-thirds of the total width; eyes not conspicuously convergent below, the face, although narrower than the frons, with its sides parallel, distinctly longer than broad; malar space nearly obliterated; antenna 35-jointed; mesoscutum more

coarsely and distinctly punctate; notauli not at all indicated; scutellum longer than broad, strongly convex; apical carina of propodeum incomplete laterally, the apical pleural area not defined; abscissula more than half as long as intercubitella; postpetiole only a little broader than petiole; second tergite fully three times as long as broad; ovipositor sheath nearly a half longer than first segment.

Black of posterior part of head reduced to a small median bilobate spot widely separated from ocellar spot; all markings of thorax the same as in *convergens* except smaller, and the U-shaped mark of mesoscutum not confluent with scutellar spot; abdomen with same pattern but brown instead of black; scape and pedicel entirely yellow, flagellum ferruginous with the apical fifth or sixth black; front and middle legs without dark markings; hind coxa yellow except a spot of piceous on outer lower side, basal joint of trochanter piceous; femur yellow with outer and inner surfaces partly ferruginous, fuscous at base and yellowish at middle of upper surface; tarsus ferruginous, apices of joints slightly darker.

*Type locality*.—Cano Saddle, Gatun Lake, Panama.

*Type*.—U.S.N.M. no. 50625.

One specimen taken by R. C. Shannon on May 8, 1923.

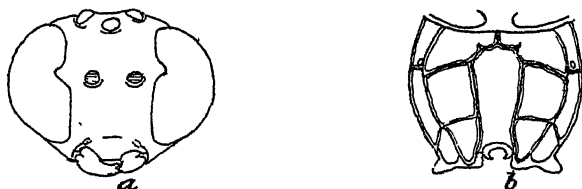


FIGURE 4.—*Brachycyrtus nawaii* (Ashmead): a, Head; b, propodeum.

BRACHYCYRTUS NAWAII (Ashmead)

FIGURE 4

*Proterocryptus nawaii* ASHMEAD, Proc. U. S. Nat. Mus., vol. 30, p. 174, pl. 12, fig. 3, 1906.

(*Brachycyrtus*) *nawai* ROMAN, Ark. für Zool., vol. 9, no. 9, p. 5, 1915.

*Proterocryptus nawaii* CUSHMAN, Proc. U. S. Nat. Mus., vol. 55, p. 543, 1919.

This Japanese species was only briefly described by Ashmead, and the following is largely a statement of characters not mentioned by him, but by which it differs from all the species described above: Ocellar triangle very strongly transverse; malar space nearly as long as basal width of mandible; occipital carina curving sharply inward to join hypostomal carina far behind base of mandible; thorax strongly punctate throughout, propodeum rugulose apically and medially; epomia strong and complete; scutellum margined only at base, its fovea margined anteriorly by a strong carina, foveolate; meso-



pleural scrobe nearly paralleling posterior margin of mesopleurum; nervulus postfurcal by more than its length; first abdominal segment slightly upcurved.

A second specimen of this species was reared at Manila, Philippine Islands, from the cocoon of a *Chrysopa*. It differs from the type virtually only in being slightly more extensively yellow and in having the propodeal areola granularly roughened rather than transversely rugulose.



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## NEW COTTID FISHES FROM JAPAN AND BERING SEA

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AMONG the cottid fishes collected by the United States Bureau of Fisheries steamer *Albatross*, and kindly submitted to me for study by Dr. G. S. Myers, of the United States National Museum, are three new forms obtained during the cruise of 1906. The figures of these were drawn by the late William S. Atkinson under the direction of the late Dr. Charles Henry Gilbert. The fourth new cottid described herein was taken by the *Albatross* in Bering Sea in 1900.

### Genus RICUZENIUS Jordan and Starks

*Genotype.*—*Ricuzenius pinetorum* Jordan and Starks.

A single specimen of a new species of fish from Yezo Strait shows so great a degree of relationship to the type species that I choose to include it in this genus. At the same time, the dissimilarities are so marked that it seems advisable to establish a new subgenus for its reception and to recharacterize the genus itself.

*Description.*—Head and body compressed throughout, deepest under anterior third of first dorsal. Maxillary extending to slightly beyond posterior margin of pupil. Anterior and posterior nostrils both in short tubes about 0.5 as long as nasal spines. Four short, simple, preopercular spines, the upper one slightly the longest; upper spine directed upward and backward, second spine backward and

downward, third spine downward, lower spine downward and forward. No other spines on head. Pores of head moderate in size, anterior pores of mandibular series paired, no single pore on median line of symphysis. Gill membranes broadly united, free from isthmus. Branchiostegals 6. Moderately broad bands of cardiiform teeth on premaxillaries, dentaries, and vomer, narrow band on palatines. Gills  $3\frac{1}{2}$ , gill rakers in the form of short tubercles. Pelvic fins of 1 spine and 3 rays, middle ray the longest, inner ray the shortest. Scales of lateral line in the form of short tubes bearing strongly ctenoid ridges dorsally and with a few moderately developed spines along the outer posterior margin. General body scales in the form of sub-oval plates, somewhat cupped from beneath and bearing transverse, ctenoid ridges posteriorly.

#### KEY TO THE KNOWN SPECIES OF RICUZENIUS

- $\alpha$ .<sup>1</sup> Maxillary scaly; scales on spines and rays of dorsal fins;  
interorbital space transversely concave-----pinetorum  
 $\alpha$ .<sup>2</sup> Maxillary naked; no scales on dorsal fins; interorbital space flat. nudithorax

#### Subgenus RICUZENIUS Jordan and Starks

Mandibular branch of lateral line system composed of clusters of small pores arranged in roughly oval patterns, the anterior pair of pores simple, enlarged. No slit behind last gill arch. Head and body almost completely covered with uniform scales, only lips, chin, gill membranes, and axilla naked.

#### RICUZENIUS PINETORUM Jordan and Starks

*Ricuzenius pinetorum* JORDAN and STARKS, Proc. U. S. Nat. Mus., vol. 27, p. 243, fig. 5, 1904; Bull. U. S. Fish Comm., vol. 22, p. 591, fig., 1902 (1904).—JORDAN, TANAKA, and SNYDER, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 33, p. 257, fig. 193, 1913.

*Diagnosis*.—Body deep, the distance from origin of first dorsal to pelvic base 4.0 (3.8–4.3) in standard length. Head large, 2.6 (2.4–2.7) in standard length. Mouth terminal, lower jaw equal to or slightly longer than upper. Interorbital space wide, 2.1 (1.8–2.3) in orbit, definitely grooved; top of head slightly concave. D. IX, 15 (14–16); A. 12 (11–13); P. 16 (16–17). Lateral line armed with 37 (35–38) scales.

In the type description of this species Jordan and Starks made the unfortunate error of stating that the ventral fins had “a concealed spine and 2 soft rays each”, the error being introduced into the key also. The true count, which Dr. G. S. Myers has been kind enough to verify on the type specimen, is I, 3.

NOVIRIOUZENIUS,<sup>1</sup> new subgenus

*Genotype*.—*Ricuzenius nudithorax*.

Mandibular branch of lateral line system composed of moderately large, simple pores. A well-developed slit behind the last gill arch. Sides of head below midline of orbit, naked; scales on ventral portion of body much reduced in size and number.

RICUZENIUS NUDITHORAX,<sup>2</sup> new species

## FIGURE 5

*Description*.—Depth of body, measured from origin of first dorsal to pelvic base, 4.8 in standard length, 1.6 in head; width at dorsal end of pectoral base 2.0 in head. Dorsal body contour forming a very gentle sigmoid curve, the ventral contour a very gentle convex curve, from the deepest point to the caudal peduncle, the least depth of which is 1.6 in orbit.

Head 3.0 in standard length; snout 1.1 in orbit, forming an angle of about 67° with chin, of about 148° with frontoparietal region. Lower jaw slightly shorter than upper, barely included. Eye rather small, diameter of orbit 3.3 in head. Interorbital space flat, its width about 4.0 in orbit, 1.5 in posterior width of maxillary. Top of head flat, without any well-defined frontoparietal ridges. Nasal spines slender, sharp, equal to about 0.6 interorbital space. Pores of head moderate in size; a series bordering suborbitals both dorsally and ventrally.

Origin of first dorsal very slightly in advance of upper end of gill opening; base of fin 1.7 in head; fin of 10 spines; the first two with approximate bases, very slightly shorter than third spine, which is longest, being 2.2 in head. Second dorsal contiguous to first dorsal; base of fin 2.6 in standard length; fin of 21 rays; first ray 2.0 in fifth ray, which is longest, being 1.9 in head. Origin of anal about under second dorsal ray, its posterior end under second ray from end of second dorsal; base of fin 2.9 in standard length; fin of 19 rays; tenth to sixteenth rays subequal and longest, being 2.6 in head. Pectoral base 3.2 in head; fin of 16 rays; longest ray 1.1 in head, extending to level of seventh anal ray. Base of pelvics behind lower end of pectoral base at a distance equal to about 0.4 pupil; length of fin 2.3 in head; fin extending about 0.6 distance to anal origin. Caudal truncate; with 9 split rays; its length 1.5 in head. Anus in advance of anal origin at a distance equal to about 0.5 orbit; located just anterior to the base of a short, bluntly conical, genital papilla, which is about equal in length to nasal spines.

<sup>1</sup> From *novus*, new + *Ricuzenius*.

<sup>2</sup> From *nudus*, naked + *thorax*, breast.

Entire interorbital space and top of head above a line from middle of posterior margin of orbit to upper end of gill opening covered with small scales; these continuous posteriorly with a band of scales of irregular size, most of them larger than those of the head, covering the entire body above the lateral line. A triangular naked patch under the anterior end of the lateral line, bordered ventrally and posteriorly by a band of enlarged scales extending upward and backward from the axilla to the arch of the lateral line; this band merges posteriorly into smaller scales, rather widely spaced and tending toward imbricated arrangement, which cover the posterior portion of the body below the lateral line with the exception of a narrow streak along the base of anal fin and ventral surface of caudal peduncle; these scales, which near the lateral line approximate the size of the dorsal scales, become minute ventrally. A few minute scales occur just anterior to the base of the pelvic fins and in a narrow, irregular, median line extending from slightly behind

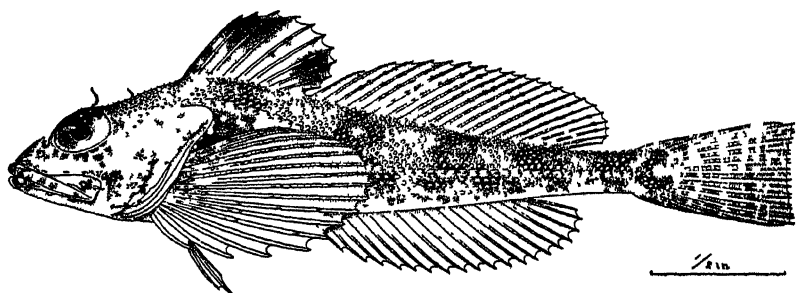


FIGURE 5—*Ricuzenius nudithorax*, new species, holotype (U S N M. no. 102104).

the base of pelvics to just in front of anus, where the line bifurcates and is continuous with the lower band of posterior body scales. A few scattered, minute scales occur dorsal to this line. The number of spines on the general body scales is roughly dependent upon the size of the scales themselves, which varies greatly. Lateral line armed with 44 large scales.

Eyeball bearing a band of small fleshy papillae bordering the iris dorsally and anteriorly; these evidently represent vestigial remnants of scale pockets, small scales being found in the same position in *Ricuzenius pinetorum*. Two minute cirri near lower margin of preorbital, one just in advance of and one behind the anterior pore. A single simple cirrus near posterior edge of maxillary; a long slender cirrus at upper posterior margin of each orbit; two similar cirri, of progressively smaller size, in line behind each of these; a simple or branched cirrus midway on suborbital stay; a simple cirrus on base of the lower two or three preopercular spines; a minute cirrus near posterior end of opercle; a single cirrus just behind the gill opening and midway between lateral line and upper

end of pectoral base; a cirrus on one or two of the lateral line scale margins under the anterior part of second dorsal; one to three cirri on about 10 scattered scale margins below the lateral line; none above lateral line.

TABLE 1.—*Measurements of holotype of Ricuzenius nudithorax*

Measurement	Mm	Percent of standard length
Standard length.....	61.3	-----
Origin of first dorsal to pelvic base.....	12.8	20.9
Origin of second dorsal to anal origin.....	11.8	19.3
Least depth of caudal peduncle.....	3.8	6.2
Distance between dorsal ends of pectoral bases.....	10.0	16.3
Length of head.....	20.4	33.3
Diameter of orbit.....	6.1	10.0
Length of snout.....	5.4	8.8
Length of maxillary.....	9.9	16.2
Snout to origin of first dorsal.....	17.7	28.9
Base of first dorsal.....	12.3	20.1
Snout to origin of second dorsal.....	29.2	47.2
Base of second dorsal.....	24.0	39.2
Snout to anal origin.....	30.2	49.3
Base of anal.....	20.8	33.9
Snout to dorsal end of pectoral base.....	18.2	29.7
Snout to ventral end of pectoral base.....	15.8	25.8
Width of pectoral base.....	6.3	10.3
Length of pectoral.....	19.2	31.3
Snout to pelvic base.....	17.1	27.9
Length of pelvic.....	8.7	14.2
Length of caudal.....	13.8	22.5
Snout to anus.....	26.7	43.6

General body color in alcohol brownish yellow. Top of head with a reddish-brown patch; cheeks marbled with the same color. Back crossed by 5 reddish-brown cross bars; the first under middle of first dorsal, extending downward and forward to upper end of pectoral base; the second, under the anterior part of second dorsal, extending downward to near base of anal; third and fourth bars, under middle and posterior end of second dorsal, bifurcating at level of lateral line and tending to merge ventrally; fifth bar on caudal peduncle sending a branch posteriorly to base of caudal fin. First dorsal marked anteriorly and posteriorly with prominent distal patches of color. Second dorsal, caudal, and pectorals barred with reddish brown. Pelvics and anal colorless.

*Holotype*.—U.S.N.M. no. 102104; a specimen 61.3 mm in standard length, from *Albatross* station 5031, Yezo Strait, Japan, lat. 44°04' N., long. 145°32' E., 86 fathoms. This is the only specimen known.

**ATOPOCOTTUS,<sup>3</sup> new genus**

*Genotype*.—*Atopocottus tribranchius*.

Preopercle armed with 4 well-developed spines, the upper one enlarged and branched. Gill membranes broadly united, free from isthmus. Branchiostegals 6. Teeth in cardiform bands on premaxillaries, dentaries, vomer, and palatines. Gills 3; no filaments on last gill arch and no slit behind it. Gill rakers in the form of short tubercles. Pelvics I, 2. Scales occurring on anterior part of lateral line only, not extending beyond end of first dorsal.

The affinities of this strange cottid are obscure. Its nearest relatives are probably to be sought among the allies of *Pseudoblennius*.

**ATOPOCOTTUS TRIBRANCHIUS,<sup>4</sup> new species**

FIGURE 6

Body slightly compressed throughout, suboval in cross section; deepest under anterior part of first dorsal, the distance from origin of first dorsal to pelvic base 1.6 (1.5–1.7) in head, width at dorsal end of pectoral base 1.8 (1.6–2.0) in head. Anterior portion of body together with head forming a suboval mass, from which the posterior portion of the body extends with almost straight dorsal and ventral contours to the caudal peduncle. At the junction of these two body masses, just posterior to the anus, occurs a distinct break in body outline. Least depth of caudal peduncle 2.4 (2.2–2.7) in orbit.

Head 2.6 (2.5–2.7) in standard length; snout 1.7 (1.4–2.0) in orbit, moderately steep, forming an angle of 70° (63°–75°) with chin, of 134° (122°–139°) with frontoparietal region. Lower jaw somewhat shorter than upper, slightly included; maxillary extending to somewhere between middle and posterior margin of pupil. Anterior nostrils in short tubes; posterior nostrils without elevated margins, indistinguishable from pores of lateral line system. Eye large, diameter or orbit 2.5 (2.4–2.6) in head. Interorbital space flat, narrow, about 2.0 in posterior width of maxillary. Top of head very gently concave. No free nasal spines and no spines on top of head. Four preopercular spines; the upper one 1.8 (1.3–2.1) in orbit, directed upward and backward, slightly curved, with a simple or bifid tip and bearing one or two secondary spines on its upper margin; these, in turn, often bifid; the three lower spines simple and sharp, their length about equal to interorbital width, the upper one directed backward, the middle one backward and downward, the lower one almost straight downward. Pores of head large; most conspicuous are the series that occur along the ventral margin of suborbital chain extending upward behind the eye, and the series along the preopercular margin continued forward as the mandib-

<sup>3</sup> From *ἄτοπος*, extraordinary + *Cottus*.

<sup>4</sup> From *τρεῖς*, three + *βράχια*, gills.

ular series, the anterior pores of which are paired; no single median pore on symphysis.

Origin of first dorsal on a perpendicular about midway between upper end of gill opening and posterior end of subopercle ("opercular flap"); base of fin 2.4 (2.2–2.8) in head; fin of 7 (7–8) spines; first two with approximate bases, usually subequal in length and longest, being 3.4 (2.9–3.7) in head; third spine shorter than second or fourth, forming a marked notch in fin outline. Second dorsal separated from first by a wide interspace 1.6 (1.1–2.1) in orbit; base of fin 1.5 (1.3–1.6) in head; fin of 11 (11–12) rays; first ray 2.0 (1.6–2.9) in fourth, fifth, or sixth ray, which is longest, being 2.3 (2.1–2.7) in head. Origin of anal under second, third, or fourth dorsal ray; its posterior end under the second, third, or fourth ray from end of second dorsal; base of fin 2.3 (2.1–2.6) in head; fin of 8 (6–9) rays; first ray 1.5 (1.1–2.2) in fourth or fifth ray, which is

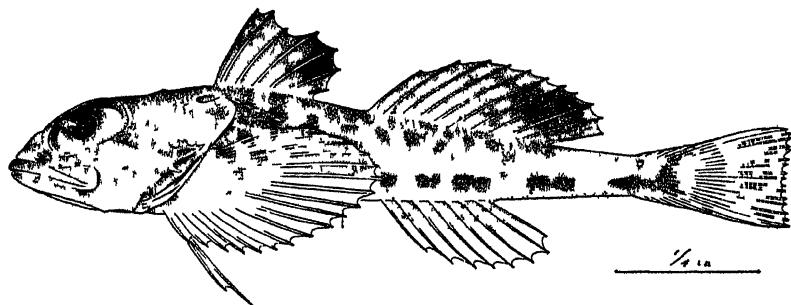


FIGURE 6—*Atopocottus tubranchius*, new species, holotype (USNM no 102105)

longest, being 2.7 (2.4–2.9) in head. Pectoral base 2.7 (2.5–2.9) in head; fin of 19 (17–20) rays; longest ray 1.3 (1.2–1.5) in head, extending to somewhere between anus and anal origin. Base of pelvics immediately behind lower end of pectoral base; fins rather widely separated, the distance between them roughly equal to distance from pelvic base to lower end of pectoral base; inner ray the longer; length of fin 1.9 (1.8–2.3) in head, extending 0.5 (0.4–0.6) distance to anal origin. Caudal truncate with 7 (6–8) split rays, its length 1.6 (1.4–1.8) in head. Anus in front of anal origin at a distance about equal to diameter of pupil; located just anterior to the base of a very short, bluntly conical, genital papilla, which in the male is free, in the female surrounded by and partly embedded in a folded fringe of skin.

Anterior part of lateral line armed with 4 (3–6) deeply embedded scales; each scale in the form of a short simple tube pierced by large fenestrae; posteriorly the lateral line is continued to base of caudal by 27 to 29 minute pores, very difficult to distinguish; their position and number may readily be determined if congealed mucus



can be peeled from the specimen, each pore leaving a clear-cut hole in the mucous film. No scales other than those of lateral line. No cirri on head or body.

TABLE 2.—*Measurements of Atopocottius tribranchius*

Measurement	Percent of standard length
Origin of first dorsal to pelvic base.....	24.0 (23.1-25.5)
Origin of second dorsal to anal origin.....	15.1 (14.2-16.8)
Least depth of caudal peduncle.....	6.3 (5.5-6.8)
Distance between dorsal ends of pectoral bases.....	21.5 (19.5-24.2)
Length of head.....	38.8 (37.2-41.3)
Diameter of orbit.....	15.4 (14.7-16.6)
Length of snout.....	9.1 (7.7-10.9)
Length of maxillary.....	16.9 (15.8-17.9)
Snout to origin of first dorsal.....	36.5 (34.7-38.6)
Base of first dorsal.....	16.1 (13.6-17.6)
Snout to origin of second dorsal.....	58.3 (55.8-63.2)
Base of second dorsal.....	26.4 (24.9-29.2)
Snout to anal origin.....	61.5 (58.8-63.2)
Base of anal.....	16.8 (15.1-18.6)
Snout to dorsal end of pectoral base.....	36.3 (35.1-37.8)
Snout to ventral end of pectoral base.....	26.6 (25.2-28.8)
Width of pectoral base.....	14.7 (13.2-16.2)
Length of pectoral.....	29.4 (26.4-31.6)
Snout to pelvic base.....	27.5 (26.4-28.8)
Length of pelvic.....	19.9 (17.9-21.3)
Length of caudal.....	24.4 (21.3-27.4)
Snout to anus.....	55.0 (52.6-56.6)

General body color in alcohol brownish yellow. Body blotched with reddish-brown spots, the anterior ones tending to merge into a broad cross bar under the anterior dorsal. Ventral surface whitish. A large diffuse reddish-brown blotch on posterior, distal portion of first dorsal, second dorsal coarsely barred with brown. A spot of same color on base of upper caudal rays. Upper pectoral rays faintly barred with reddish brown; a spot of brown at the base of these rays. Pelvics and anal colorless.

*Holotype*.—U.S.N.M. no. 102105; a male specimen 27.7 mm in standard length; from *Albatross* station 4816, lat. 38°14' N., long. 138°54' E., in 64 fathoms.

*Paratypes*.—U.S.N.M. no. 102106; 7 specimens 23.0-28.5 mm in standard length, from *Albatross* station 4817, lat. 38°12' N., long. 138°52' E., in 61 fathoms; Nat. Hist. Mus. Stanford Univ. no. 30457; 3 specimens 22.6-27.0 mm in standard length, from *Albatross* station 4815, lat. 38°16' N., long. 138°52' E., in 70 fathoms. These stations are all off Nugatu, Japan.

This species is apparently the smallest of the cottids, the series of specimens evidently representing adults. The largest specimen, a female 28.5 mm in standard length, contains well-developed eggs.

Eight of the 11 specimens are infested by a copepod parasite of the family Lernaeidae, which attaches itself to the eye.

#### PHASMATOCOTTUS,<sup>5</sup> new genus

*Genotype*.—*Phasmatocottus ctenopterygius*.

Preopercle armed with four well-developed spines, the upper one enlarged and antlerlike. Gill membranes united, joined to isthmus, forming a fold across it. Branchiostegals 6. Cardiform teeth in a double series on anterior part of premaxillary and dentaries, merging into a wide band posteriorly, widely spaced in a single series on vomer, none on palatines. Gills  $3\frac{1}{2}$ , no slit behind fourth arch; gill rakers in the form of short tubercles. Dorsal spines unconnected by membrane; a single minute spine (?) at origin of anal; pelvics 1-2. No scales other than those of lateral line. Lateral line pores double.

This genus probably represents an ancient offshoot from the *Zesticelus* line of development.

#### PHASMATOCOTTUS CTENOPTERYGIUS,<sup>6</sup> new species

##### FIGURE 7

Head and anterior part of body depressed, posterior part subcircular in section; body deepest at anterior end of first dorsal, distance from origin of first dorsal to pelvic base 2.1 in head; width at dorsal end of pectoral base 1.9 in head. Ventral body contour gently rounded anteriorly; dorsal contour and posterior part of ventral contour forming almost straight lines from origin of first dorsal and from anus, respectively, to caudal peduncle, the least depth of which is 2.3 in orbit.

Head 2.6 in standard length; snout 1.3 in orbit, not steep, forming an angle of about  $58^\circ$  with chin, of about  $138^\circ$  with frontoparietal region; mouth terminal, lower jaw equal to upper; maxillary extending to slightly beyond anterior margin of pupil. Anterior and posterior nostrils in short tubes the anterior ones almost as long as nasal spines, posterior ones about half as long. Size of eye moderate, diameter of orbit 3.0 in head. Interorbital space narrow, about 1.3 in posterior width of maxillary; top of head gently concave. Nasal spines small, sharp, erect, their length equal to about 0.7 interorbital space; a pair of very small but sharp spines on top

<sup>5</sup> From *φάσμα*, specter + *Cottus*.

<sup>6</sup> From *κτενίς*, to comb + *πτερύγιον*, fin.

of head at posterior end of frontoparietal ridges, directed backward and inward; preopercle armed with 4 spines, the upper one about 1.1 in orbit, directed upward and backward, slightly curved; on the left side of the type it has a simple tip and two strong recurved barbs along its upper margin; on the right side both the tip and the single recurved barb are bifid; the three lower preopercular spines simple, sharp, somewhat longer than nasal spines, the upper two directed downward and backward, the lower one downward and forward. Pores of head very large and conspicuous; the suborbital chain of bones bordered dorsally and ventrally by large pores; the upper series continued around the orbit; those pores that are dorsal and posterior to the eye opening through the skin of the eyeball itself instead of in interorbital space; the lower series continued backward on cheek to near base of upper preopercular spine, from which point

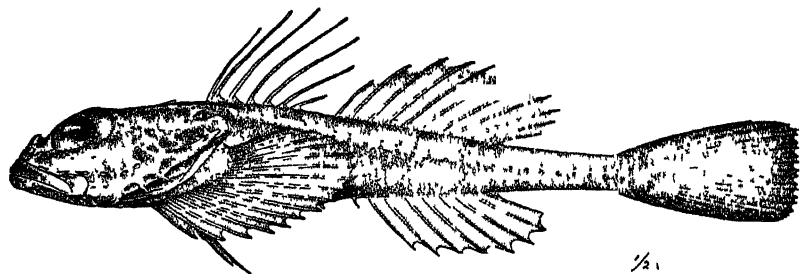


FIGURE 7.—*Phasmatocottus ctenopterygius*, new species. The true formula of the dorsal fins of the type is VI, 12, not VII, 11, as shown in the figure, which may have been made from a second specimen, since lost.

it swings dorsally; pores of marginal preopercular series continued forward as large simple mandibular pores, the anterior pair opening in a common pit on the median line of symphysis.

Origin of first dorsal very slightly behind upper end of gill opening; base of fin 2.5 in head; fin of 6 detached spines unconnected by membrane, the first two with approximate bases; first spine 1.3 in third spine, which is longest, being 1.8 in head. Second dorsal separated from first by an interspace about 2.1 in orbit; base of fin 1.5 in head; fin of 12 rays, first ray 1.5 in seventh ray, which is longest, being 2.3 in head. Origin of anal about under second dorsal ray, its posterior end under second ray from end of second dorsal; base of fin 1.7 in head; fin of 1 detached spine (?)<sup>7</sup> and 8 rays. First

<sup>7</sup> The small structure at the anterior end of the anal fin in this fish certainly appears to be a spine, although it may possibly be the basal portion of a broken ray that has attained a sharp point and smooth appearance. It is only the absence of anal spines in all other cottids except *Ochotskia armata* Schmidt, with which this species shows no close relationship, that causes me to question its character. It may be possible that this species has retained one anal spine as a primitive feature, and only examination of a second specimen can clear up this point.

anal ray 1.2 in third ray, which is longest, being 2.6 in head. Pectoral base 2.3 in head; fin of 18 rays; longest ray 1.7 in head; fin extending to level of third dorsal ray. Base of pelvics behind lower end of pectorals at a distance about equal to posterior width of maxillary; inner ray the longer, extending about 0.7 distance to anus. Caudal truncate, with 8 split rays, its length 1.6 in head. Anus in front of anal origin at a distance about 2.5 in orbit; located just anterior to the base of a slender, fingerlike, genital papilla, about as long as nasal spine.

Lateral line armed with 27 delicate, deeply embedded scales, each scale in the form of an incomplete tube, the lateral face open, dorsal and ventral surfaces pierced by several fenestrae. Pores of lateral line occurring in a double series, each pore of the lower series matched by a smaller one directly above it. No scales other than those of lateral line. A single minute cirrus on dorsal part of eyeball, no others on head or body.

TABLE 3.—*Measurements of holotype of Phasmatocottus ctenopterygius*

Measurement	Mm	Percent of standard length
Standard length.....	38.0	-----
Origin of first dorsal to pelvic base.....	7.0	18.4
Origin of second dorsal to anal origin.....	4.7	12.4
Least depth of caudal peduncle.....	2.1	5.5
Distance between dorsal ends of pectoral bases.....	7.6	20.0
Length of head.....	14.6	38.4
Diameter of orbit.....	4.8	12.6
Length of snout.....	3.6	9.5
Length of maxillary.....	5.7	15.0
Snout to origin of first dorsal.....	13.1	34.5
Base of first dorsal.....	5.9	15.5
Snout to origin of second dorsal.....	20.4	53.7
Base of second dorsal.....	9.9	26.0
Snout to anal origin.....	20.5	54.0
Base of anal.....	8.4	22.1
Snout to dorsal end of pectoral base.....	14.0	36.8
Snout to ventral end of pectoral base.....	9.0	23.7
Width of pectoral base.....	6.3	16.6
Length of pectoral.....	8.8	23.2
Snout to pelvic base.....	10.4	27.4
Length of pelvic.....	6.3	16.6
Length of caudal.....	9.0	23.7
Snout to anus.....	18.7	49.2

Color in alcohol pale brownish yellow, with practically no indication of markings.

*Holotype*.—U.S.N.M. no. 102107; a specimen 38 mm in standard length, from *Albatross* station 5050, off Sendai Bay, Japan, lat. 38°11'30" N., long. 142°08'00" E., in 266 fathoms. This is the only specimen known.

**STLEGICOTTUS,<sup>8</sup> new genus**

*Genotype*.—*Stlegicottus xenogrammus*.

Preopercle armed with 4 simple spines. Gill membranes broadly united, free from isthmus; branchiostegals 6. Teeth in moderately broad cardiform bands on premaxillaries, dentaries, and vomer, in narrow bands on palatines. Gills 3½; no slit behind fourth arch; gill rakers in the form of short tubercles. Pelvics I, 3. Lateral line not extending beyond end of anal fin.

This is an isolated genus probably representing an early offshoot from the line of descent that later gave rise to *Ricruzenius* on the one hand and the *Artedius-Stelgistrum* group on the other.

**STLEGICOTTUS XENOGRAMMUS,<sup>9</sup> new species**

FIGURE 8

Head and anterior portion of body forming a subovate mass from which the posterior part of the body extends with a broad transverse groove forming a line of demarcation ventrally at the level of the anal origin; body slightly compressed throughout; deepest at anterior end of first dorsal, the distance from the origin of first dorsal to pelvic base 1.8 in head; width at dorsal end of pectoral base 2.4 in head. Dorsal contour almost straight posterior to origin of first dorsal; ventral contour forming a double convex curve, the anterior curve well marked between the mouth and anal origin, the posterior curve very gentle, extending between anal origin and caudal peduncle, the least depth of which is 2.4 in orbit.

Head 2.6 in standard length. Snout 1.6 in orbit, moderately steep, forming an angle of 64° with chin, of 143° with frontoparietal region; lower jaw very slightly shorter than upper jaw, barely included; maxillary extending beyond middle of pupil but not reaching its posterior margin. Anterior nostrils in well-developed tubes about 0.5 as long as nasal spines; posterior nostrils without elevated margins, indistinguishable externally from mucous pores. Size of eye moderate, orbit 2.9 in head. Interorbital space flat, narrow, about 1.7 in posterior width of maxillary; top of head very gently concave. Nasal spines sharp, moderate in size, about 1.3 in interorbital space; preopercular spines short, simple, sharp; the upper one the longest, about equal to interorbital width, directed upward and backward,

<sup>8</sup> From στλεγγίς, a scraper + *Cottus*.

<sup>9</sup> From ξένος, strange + γραμμή, line.

second spine directed backward, third spine backward and downward, fourth spine downward and forward. Pores of head well developed; suborbital series very large, their vertical or lesser diameter equal to 0.5 suborbital width; a few minute pores above these; preopercular-mandibular series also large, the anterior pores paired.

Fins in poor condition in the unique type, most of the rays broken and the membrane completely gone. Origin of first dorsal directly over upper end of gill opening; base of fin 2.1 in head; fin of 9 spines, the first two with approximate bases; first spine 1.3 in third and fourth spines, which are subequal and longest, being 2.8 in head. Second dorsal separated from first by a narrow interspace

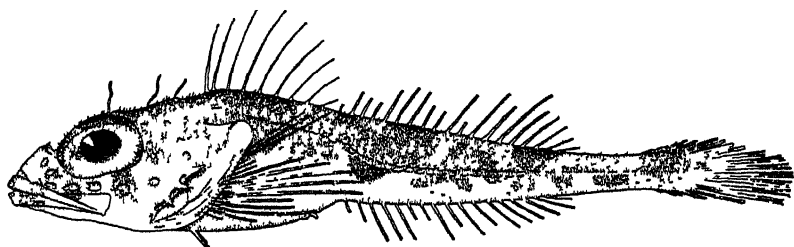


FIGURE 8—*Stlegicottus xenogrammus*, new species, holotype (USNM. no. 102108).

equal to about 0.4 posterior width of maxillary; base of fin 1.1 in head; fin of 19 rays. Origin of anal about under second dorsal ray, its posterior end under second ray from end of second dorsal; base of fin 1.3 in head; fin of 17 rays. Pectoral base 3.4 in head; fin of 18 rays. Base of pelvics very slightly behind lower end of pectoral base. Anus advanced from anal origin about 0.25 distance to pelvic base; located immediately in front of a very short, bluntly conic, genital papilla.

Head behind the eyes and dorsal to the midlevel of the posterior orbital border covered with minute scales, a few scattered elements extending anteriorly throughout the interorbital space and occurring sparsely on the upper portion of the eyeball; the scaled area of head continuous with a broad band of slightly larger scales covering the entire dorsal surface of the body; similar scales form a streak below the lateral line extending from just behind the axilla to base of caudal and occupying approximately the dorsal 0.6 of the region between lateral line and base of anal. These scales are in the form of small oval plates bearing a single spine posteriorly, which is rarely bifurcated. Lateral line armed with about 30 scales, which are in the form of short incomplete tubes, the outer part broken by a wide longitudinal slit, a single moderately strong spine at the upper posterior angle and another at the lower posterior angle. The armature of the lateral line extends almost to the end of the anal fin; no

pores are visible posterior to this point. A long slender cirrus, about equal to diameter of pupil, at upper posterior margin of orbit; two similar cirri in line behind this, one on the middle of frontoparietal ridge and one at its posterior end; a single slender cirrus near posterior end of opercle; no cirri on body.

TABLE 4.—Measurements of holotype of *Stlegicottus xenogrammus*

Measurement	Mm	Percent of standard length
Standard length.....	29.1	-----
Origin of first dorsal to pelvic base.....	6.3	21.6
Origin of second dorsal to anal origin.....	4.1	14.1
Least depth of caudal peduncle.....	1.6	5.5
Distance between dorsal ends of pectoral bases.....	4.8	16.5
Length of head.....	11.3	38.8
Diameter of orbit.....	3.9	13.4
Length of snout.....	2.4	8.2
Length of maxillary.....	5.2	17.9
Snout to origin of first dorsal.....	9.8	33.7
Base of first dorsal.....	5.3	18.2
Snout to origin of second dorsal.....	14.9	51.2
Base of second dorsal.....	10.1	34.7
Snout to anal origin.....	15.1	51.8
Base of anal.....	8.7	29.8
Snout to dorsal end of pectoral base.....	10.3	35.4
Snout to ventral end of pectoral base.....	8.6	29.5
Width of pectoral base.....	3.3	11.3
Snout to pelvic base.....	8.7	29.9
Snout to anus.....	13.3	45.7

General body color in alcohol brownish yellow; three reddish-brown bars extending downward from eye, the first toward tip of lower jaw, the second to base of expanded portion of maxillary, the third to just behind the maxillary, where it spreads out posteriorly on the preopercle; dorsal portion of body marked with similar color, which tends to form diffuse cross bars extending to well below the lateral line; the three most distinct bars are under the middle of first dorsal and under the anterior and posterior thirds of second dorsal; almost no indication of color on fins except a reddish-brown blotch on middle of pectoral base.

*Holotype*.—U.S.N.M. no. 102108; a specimen 29.1 mm in standard length from *Albatross* station 3785, in the south-central Bering Sea, 150 miles north of the Rat Islands; depth 270 fathoms.



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REVISION OF THE NORTH AMERICAN BEETLES OF  
THE STAPHYLINID SUBFAMILY TACHYPORINAE—  
PART 1: GENUS TACHYPORUS GRAVENHORST

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ONLY once have the American species of beetles of the genus *Tachyporus* been monographed, and nearly 60 years have passed since that time. Only one new species has been described and little added to the knowledge of the genus since Horn's revision in 1877.<sup>1</sup> The members of this genus have always been considered difficult to differentiate because of their feeble characters. Horn states that they "resemble each other so closely that it is only with difficulty that they can be described, so that their feeble differences may be made apparent." This is to some extent due to the fact that color has been used almost exclusively for distinguishing the species, in spite of the recognized fact that this character is frequently very variable. Certain species are distinct and may be readily separated by the color pattern, but with others great confusion has been brought about by the attempts to separate the species in this way.

Even the structural characters available are few and rather feeble. An attempt to utilize the genitalia of both the male and female has led me to the conclusion that the very slight and inconstant differ-

<sup>1</sup> Horn, George II, Synopsis of the genera and species of the staphylinide tribe Tachyporini of the United States. Trans. Amer. Ent. Soc., vol. 6, pp. 81-128, pl. 1, 1877.



ences in these structures cannot be used for specific segregation. In this study only the larger punctures of the elytra have been found to be of value, and their constancy appears to be sufficient to justify their use.

Chiefly owing to the exclusive use of color as a distinguishing character, several of the common American species have been completely confused under two or three names. The supposed recognition of the European *chrysomelinus* from this country only served to increase the difficulty. Under the name *jocosus* and *chrysomelinus* have been included indiscriminately at least three common species, as is demonstrated by the fact that the Horn collection contains all three of these species under each name. The names *maculicollis* of LeConte and *acaudus* of Say have in the past been suppressed on the basis of color similarities.

Because of the loss of the Say types, it is impossible to be sure of his species. His descriptions, in combination with the type localities, seem to be sufficient to distinguish both *jocosus* and *acaudus*.

No specimen from America has been seen that can be placed with European specimens of *chrysomelinus*. This species runs in our key to *rutomus* but differs especially from that species by the absence of the extra discal puncture near the humerus of the elytra.

Because of this confusion and the incorrect statements in Horn's descriptions and synonymy of *jocosus* and *chrysomelinus*, it is impossible to use any of the records published for these species. It cannot be determined, except from the specimens, to which of the valid species they belong. This is also true to a large extent of *scitulus*, *nanus*, *californicus*, and *elegans*.

Certain of the characters used in the key need explanation. The large setiferous punctures of the elytra are arranged in a regular pattern, which holds throughout the genus and consists of a series of one to four punctures along the suture, a series of three to five along the lateral margin, a series of one to three along the apical margin, and five or six punctures forming an oblique quadrilateral on the disk. Any of these punctures may disappear in certain species, but the basal members of the sutural and lateral series are more permanent than the apical members. The sutural series is said to be present if one puncture of this series remains on each elytron. The "median discal puncture" is situated at basal third at the middle of the disk. The maculation of the pronotum is sometimes very faint and diffuse, but the immaculate forms are never darker at the center of the disk. The folding of the hind wings beneath the elytra frequently forms a small triangular black spot at the scutellum, which is visible through the elytra. This is not considered to invalidate the statement "elytra without large scutellar black spot."

The material available for this study consists of approximately 1,100 specimens from our region and a small series of species from Central America, the West Indies, and Europe. These comprise the United States National Museum collections and my own. In addition, the collections of LeConte and Horn have been critically examined.

I am indebted to Dr. E. A. Chapin, of the United States National Museum, for providing facilities for studying the specimens in the Museum's collection and also for many other kindnesses. The Academy of Natural Sciences of Philadelphia and the Museum of Comparative Zoology have greatly aided the study by allowing the examination of the Horn and LeConte collections, respectively.

#### Genus TACHYPORUS Gravenhorst

1802. *Tachyporus* GRAVENHORST, Coleoptera Microptera Brunsvicensia . . . , p. 124. [Genotype: *Staphylinus chrysomelinus* Linnaeus (1758), through synonymy with *Oxyporus chrysomelinus* Fabricius (1792); designated in 1810 by Latreille (Considérations générales . . . , p. 183).]

Head smooth, inclined, narrower than the prothorax and more or less inserted in the latter, not margined at the sides beneath the eyes; antennae feebly clavate, 11-segmented, inserted at the sides of the front of the head; fourth segment of the maxillary palpi subulate; segments of labial palpi gradually diminishing in thickness; ligula bilobed, paraglossae not projecting; no ocelli. Pronotum smooth; front coxae conical, prominent; trochanters distinct. Elytra longer than the pronotum, minutely and irregularly punctate; epipleurae distinctly limited by a carina. Mesosternum not carinate. Tarsi 5-segmented, first segment of hind tarsi moderate or short, posterior coxae free, contiguous, transverse, expanded portion attaining the epimeron; tibiae with a fringe of unequal spinules at tip. Abdomen narrowly margined; eighth sternite<sup>2</sup> of male notched at middle; eighth tergite of female divided into four slender processes.

Gravenhorst erected *Tachyporus* in 1802 in his Coleoptera Microptera Brunsvicensia for three species of *Staphylinus*, five of *Oxyporus*, and six new species. In 1806 he again described the genus (Monographia Coleoptera Microptera), citing his earlier publication of it (p. 1), and listing 26 additional species. Almost every subsequent writer has cited the genus as dating from the later date, though this is certainly erroneous.

<sup>2</sup> The abdominal segments are referred to by their morphological number rather than by the apparent one. The eighth sternite is the sixth visible one. For a complete discussion of this principal, see Blackwelder, Morphology of the coleopterous family Staphylinidae, Smithsonian Misc. Coll., vol. 94, no. 13, 1930.

Twelve names have been proposed for American species of *Tachyporus*, of which eight were considered valid by Horn. Blatchley and Sharp have each described one additional species. Of these 14 names 9 are considered valid by the writer, and 8 new ones are proposed. The species described by Sharp in the *Biologia Centrali-Americana* from northern Mexico is tentatively identified with United States material.

## KEY TO NORTH AMERICAN SPECIES OF TACHYPORUS

1. Elytra with oblique discal spot black..... maculipennis  
Elytra without oblique discal black spot..... 2
2. Elytral suture with series of submuricate punctures..... 3  
Elytral suture without submuricate punctures..... 8
3. Body convex and robust, prothorax not decidedly broader than  
elytra..... 4  
Body narrow and depressed, prothorax obviously broader than  
elytra..... nitidulus
4. Body above black, apex of elytra alone paler..... nanus  
Color piceous to pale, not as above..... 5
5. Pronotum paler at sides or at base..... 6  
Pronotum unicolorous, pale..... rufomus
6. Basal fifth only of pronotum paler..... tehamae  
Base and sides of pronotum indefinitely paler..... 7
7. Eighth sternite of female broadly rounded..... californicus  
Eighth sternite of female feebly emarginate..... stejnegeri
8. Pronotum uniform in color throughout..... 9  
Pronotum maculate or at least clouded at center..... 12
9. Elytra with large scutellar black spot and last abdominal seg-  
ments indistinctly darker..... elegans  
Elytra without large scutellar spot, abdomen unicolorous..... 10
10. Elytra marked with darker areas..... 11  
Elytra unicolorous..... jocosus
11. Marginal series of five punctures; no additional discal puncture  
at humerus..... snyderi  
Marginal series of five punctures; with an additional discal  
puncture near the humerus..... temacus
12. Basal fourth of pronotum and basal half of elytra black..... pulchrus  
Thorax maculate at center or in apical half..... 13
13. Each elytron with sutural black spot extending to apical fourth..... oregonus  
Elytra without large black discal spot..... 14
14. Elytra with an additional humeral puncture just inside the  
lateral series..... 15  
Elytra without additional humeral puncture..... acaudus
15. Marginal series of three punctures..... arizonicus  
Marginal series of four punctures..... 16
16. Elytra with median discal pair of large punctures..... alleni  
Elytra with a single median discal puncture..... mexicanus

The species herein described have the following characters in common; these have been omitted from the specific descriptions, but they apply to all the species listed:

Size 2 to 3 mm, depending chiefly on the degree of extension of the abdomen. Head above smooth, shining, extremely minutely and indistinctly punctate; beneath opaque, gula smooth, shining, and somewhat elevated. Antennae a little longer than the head and pronotum, segments gradually expanded apically, last segment obliquely truncate. Pronotum smooth, shining, impunctate except for the marginal punctures.

**TACHYPORUS NITIDULUS (Fabricius)**

1781. *Staphylinus nitidulus* FABRICIUS, Species insectorum . . . , vol. 1, p. 337.  
1792. *Oxyporus brunneus* FABRICIUS, Entomologia systematica . . . , vol. 1, pt. 2, p. 535.  
1834. *Tachyporus faber* SAX, Trans. Amer. Phil. Soc., vol. 4, p. 468.  
1877. *Tachyporus scitulus* ERICHSON, HORN, Trans. Amer. Ent. Soc., vol. 6, p. 105.  
1877. *Tachyporus brunneus* (Fabricius) HORN, Trans. Amer. Ent. Soc., vol. 6, p. 105.  
1916. *Tachyporus nitidulus* (Fabricius) BERNHAUER and SCHUBERT, Coleopterorum catalogus, pars 67, p. 475.

Form depressed, narrow, and parallel. Uniformly rufotestaceous, varying to rufopiceous occasionally, head frequently darker and the elytra usually paler. Antennae with segments 7 to 10 wider than long. Third segment of maxillary palpi short and expanded distally, fourth very short but conical and large at base. Pronotum with sides regularly arcuate; slightly wider than the elytra. Elytra very finely irregularly punctured, the punctures indistinctly or bluntly submuricate; a row of two or three large punctures along the suture; lateral series with four punctures, and an additional discal puncture near the humerus. Abdomen above punctured like the elytra or a little less distinctly; beneath with a few larger muricate punctures on the apical segments. Eighth tergite of male with a feeble, rounded lobe; eighth sternite with a triangular notch, about as deep as wide, with the apex rounded. Eighth tergite of female divided into four lobes equal in length, the median pair narrower and separated one-half toward base; eighth sternite very feebly emarginate at middle and with a group of silken hairs on each side of the emargination.

*Type locality*.—Not recorded in original description.

*Localities represented*.—Massachusetts, New York, New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, Kentucky, Ohio, Michigan, Indiana, Iowa, Nebraska, North Dakota, Louisiana, Kansas, Colorado, Texas, New Mexico, Wyoming, Utah, Idaho, California, Oregon, Washington, Ontario, Lake Superior, Alberta, Saskatchewan, British Columbia, Europe.

*Remarks*.—A widespread species, probably occurring throughout our territory, though no specimens from the Southeastern States

have been seen. It has not been recorded from Mexico or Central America. This species is quite distinct from any other, only *nanus* being similar; it is distinguished from *nanus* by its pale color and narrow, depressed form.

*T. scitulus* Erichson (1839) is said by European workers to be the same as *T. macropterus* Stephens (1832). If Horn's identification is correct, then *macropterus* also may be a synonym of *T. nitidulus* (Fabricius).

**TACHYPORUS NANUS Erichson**

1840. *Tachyporus nanus* ERICHSON, *Genera et species staphylinorum*. . . , p. 240.

1877. *Tachyporus nanus* Erichson, HORN, *Trans. Amer. Ent. Soc.*, vol. 6, p. 105.

Form rather parallel, convex. Black; antennae, trophi, narrow basal margin of pronotum, apical third of elytra, legs, and apical margins of abdominal segments rufotestaceous. Antennal segments gradually expanding from the third, but all longer than wide, terminal just less than twice as long as the tenth. Third segment of maxillary palpi moderately expanded, fourth acicular. Pronotum with sides regularly arcuate; not distinctly wider than elytra. Elytra very indistinctly and not very densely submuricately punctured; with sutural row of large muricate punctures; lateral series with four punctures. Abdomen above less distinctly punctured, the punctures excavated behind, beneath with the excavations long and anastomosing to form ridges between the adjacent punctures. Eighth tergite of male evenly rounded; eighth sternite notched, the notch small, as deep as wide, the apex narrowly rounded. Eighth tergite of female 4-lobed, the median pair narrower, separated almost to base; eighth sternite broadly rounded and with a continuous series of silken hairs.

*Type locality*.—Pennsylvania.

*Localities represented*.—Michigan, District of Columbia, Pennsylvania.

*Remarks*.—A specimen of this species from Michigan in the LeConte collection in the Museum of Comparative Zoology, at Cambridge, Mass., bears a lectotype label with the number 7350!

**TACHYPORUS RULOMUS, new species**

Form robust and moderately convex. Rufopiceous; basal segment of antennae, trophi, head beneath, prothorax, and legs testaceous. Antennae with segments all longer than broad, eleventh barely one-half longer than tenth. Third segment of maxillary palpi feebly enlarged, fourth acicular. Pronotum with sides straight in apical third; not wider than elytra. Elytra very finely and irregularly submuricately punctured, the punctures frequently arranged in

transverse groups; with an irregular series of larger punctures along the suture but unusually distant from it; lateral series with four punctures and with an additional discal puncture near the humerus. Abdomen above a little more distinctly punctured than elytra; penultimate segment with a transverse row of large punctures; beneath punctures more distinctly muricate; a few of the large bluntly muricate punctures on the apical segments. Eighth tergite of male rounded; eighth sternite feebly notched, the notch twice as wide as deep, the apex rounded and the angles feeble. Eighth tergite of female 4-lobed, the median pair a little longer, narrower, and separated two-thirds to base; eighth sternite narrowly rounded, with a single series of silken hairs.

*Type locality*.—Alaska, between Rapid River and Rampart House.

*Types*.—Holotype (a female collected from between Rapid River and Rampart House, Alaska, June 14, 1912, by J. M. Jessup) and 19 paratypes (same data), U.S.N.M. no. 50895; 4 paratypes (same data) in collection of the writer.

*Localities represented*.—Sixty-seven other specimens represent the following additional localities: Alaska (100 miles north of Rampart House; Porcupine River, 100 miles north of Fort Yukon), British Columbia (Victoria, Vancouver Island), Washington (Pullman; Tenino), California (Humboldt County; San Francisco County), Alberta (Banff Springs; McLeod), Saskatchewan (Swift Current; Oxbow), Montana (Helena; Bear Paw Mountains), Wyoming (National Park), Michigan (Sault Sainte Marie; Michepocoten; Isle Royal; Whitefish Point; Gargantua; Pointe Aux Pins).

This is a common northern species hitherto confused in the complexes known under the names *jocosus* and *chrysomelinus*.

#### TACHYPORUS TEHAMAE, new species

Form robust and moderately convex. Light brown, head above and disk of pronotum somewhat darker. Antennae with segments all elongate, apical only one-half longer than the tenth. Third segment of maxillary palpi scarcely dilated, fourth long, acicular. Pronotum with transverse band of basal fifth paler than the rest; sides straight from basal third; not wider than the elytra. Elytra very finely and irregularly but densely submuricately punctured, punctures frequently in transverse rows; irregular sutural row of larger punctures present; marginal row of five punctures, and with a submarginal row of three. Abdomen above more feebly punctured than elytra; beneath a little more distinctly than above, with a few of the larger punctures on the apical segments. Eighth tergite of male rounded; eighth sternite with triangular notch, the notch one-half wider than deep, apex not rounded, angles obsolete. Eighth ter-

gite of female 4-lobed, the middle pair a little longer and narrower; eighth sternite rounded and with a single series of silken hairs.

*Type locality*.—Tehama County, Calif.

*Types*.—Holotype (male collected from Tehama County, Calif., April 27, 1913, by F. W. Nunenmacher), U.S.N.M. no. 50896; 2 paratypes (same data) in collection of the writer.

*Remarks*.—This species has only been collected once, but the differences between it and *californicus* seem constant and of sufficient importance to separate it specifically.

#### TACHYPORUS CALIFORNICUS Horn

1877. *Tachyporus californicus* HORN, Trans. Amer. Ent. Soc., vol. 6, p. 104.

Form robust and convex. Piceous; basal half of antennae, margins of pronotum, prothorax beneath, elytra, and legs slightly paler. Antennal segments all elongate, but last four slightly expanded, eleventh less than twice as long as tenth. Third segment of maxillary palpi enlarged, fourth acicular. Pronotum with sides regularly arcuate; not wider than the elytra. Elytra castaneous, very finely and densely punctate and pubescent; with a row of two or three large muricate punctures along the suture; lateral series with four punctures, and a submarginal series of three. Abdomen above less distinctly punctured, beneath more sparsely and with a few larger muricate punctures on the apical segments. Eighth tergite of male slightly prolonged in a broad lobe; eighth sternite with a triangular notch, somewhat broader than deep and with the apex broadly rounded. Eighth tergite of female divided into four lobes, the median pair narrower and separated to base; eighth sternite evenly rounded and with a single series of silken hairs.

*Type locality*.—Hunters Point, San Francisco County, Calif.

*Lectotype*.—Acad. Nat. Sci. Phila. no. 3139; labeled "Cal." and "Hunter's Point."

*Localities represented*.—The present collection includes specimens from the following localities: California (Humboldt County, Siskiyou County, Shasta County, Plumas County, Mendocino County, Marin County, San Francisco County, Alameda County, Contra Costa County, Sacramento, San Mateo County, Santa Clara County, Santa Cruz County, Yuba County, Eldorado County, Stanislaus County, Tuolumne County, Sierra County, San Joaquin County, Mariposa County, Tulare County, Monterey County, Kern County, Inyo County, Los Angeles County, San Diego County). The Horn collection contains a specimen from Oregon and Dr. W. M. Mann has recorded one specimen from Pullman, Wash.

*Remarks*.—This is a very common species throughout California. It varies considerably in color but usually maintains the general

plan. The sutural series of punctures is variable, the pair at apical third and the basal pair being the most persistent.

A specimen from San Francisco, Calif., in the LeConte collection at the Museum of Comparative Zoology bears a lectotype label no. 7349, but a specimen in the Horn collection is herein designated the lectotype.

**TACHYPORUS STEJNEGERI, new species**

1898. *Tachyporus focosus* LINELL and SCHWARZ (not Say), in Stejneger's "Asiatic Fur-Seal Islands and Fur-Seal Industry", pt. 4, appendix 1, p. 333.

Form robust and convex. Piceous; antennae, trophi, prothorax, elytra, and legs testaceous; antennae darker distally, pronotum broadly clouded on disk, elytra with sutural band, median sutural spot and marginal band darker. Antennae with all segments longer than wide; eleventh one-half longer than tenth. Third segment of maxillary palpi enlarged, fourth normal but blunt and short. Pronotum with sides straight in apical half; not distinctly wider than elytra. Elytra very finely and irregularly submuricately punctured; with sutural series of larger punctures more distant from the suture than usual; marginal series with four punctures. Abdomen above punctured a little more distinctly than elytra; beneath less finely and with numerous of the larger bluntly muricate punctures on the apical segments. Eighth tergite of male broadly rounded; eighth sternite triangularly notched, the notch a little broader than deep, the apex narrowly rounded, the angles not prominent. Eighth tergite of female 4-lobed, the middle pair narrower and separated almost to base; eighth sternite broadly truncate or very feebly emarginate, with a continuous series of silken hairs.

*Type locality*.—Nikolski, Bering Island, Bering Sea.

*Types*.—Holotype (a male collected from Nikolski, Bering Island, 1882, by Dr. L. Stejneger) and 1 paratype, U.S.N.M. no. 50897; 1 paratype in collection of the writer; paratypes collected by Dr. L. Stejneger at same locality in 1922.

*Remarks*.—This species is very similar to *californicus* but appears to be distinct. When a complete collection from the intervening areas is available, the true status can be determined.

**TACHYPORUS MACULIPENNIS LeConte**

1866. *Tachyporus maculipennis* LeConte, Proc. Acad. Nat. Sci. Philadelphia, vol. 18, p. 374.

1877. *Tachyporus maculipennis* LeConte, Horn, Trans. Amer. Ent. Soc., vol. 6, p. 103.

Form robust and convex. Piceous; antennae, trophi, prothorax, elytra, and legs testaceous, elytra with an oblique discal black spot



and irregular humeral band; pronotum generally vaguely clouded at middle. Third segment of maxillary palpus feebly expanded, fourth acicular. Antennal segments all longer than broad; eleventh one-half longer than tenth. Pronotum with sides nearly straight in apical half; not wider than elytra. Elytra finely irregularly punctate, the punctures submuricate, though indistinct; sometimes with two or three sutural punctures. Abdomen above more regularly and distinctly punctured than elytra, more feebly apically; beneath with the punctures more distinctly muricate, and with numerous large bluntly muricate punctures on the apical segments. Eighth tergite of male broadly rounded; eighth sternite triangularly notched, notch a little wider than deep, the angles obsolete. Eighth tergite of female 4-lobed, the median pair narrower and separated almost to base and slightly longer than the laterals; eighth sternite broadly rounded and with a single series of silken hairs.

*Type locality*.—Louisiana.

*Lectotype*.—Mus. Comp. Zool. no. 6494, bearing only an orange disk and a determination label by Horn.

*Localities represented*.—The present collections contain specimens from the following localities: Vermont, Massachusetts, New York, Ohio, Michigan, Indiana, Illinois, Iowa, Nebraska, North Dakota, Colorado, Utah, Manitoba, British Columbia. This species has been recorded also from Georgia, New Mexico, and Connecticut.

*Remarks*.—This species is quite distinct and is readily recognized by its color pattern. Even in very pale specimens the elytral spots are distinguishable in the difference in transparency of those areas.

#### TACHYPORUS ELEGANS Horn

1877. *Tachyporus elegans* HORN, Trans. Amer. Ent. Soc., vol. 6, p. 103.

Form robust and convex. Rufopiceous; head and scutellar spot black; abdomen darker or last two segments alone black. Antennal segments 7 to 11 expanded, but all longer than wide, eleventh almost twice as long as tenth. Third segment of maxillary palpi only slightly dilated, fourth acicular. Pronotum with sides straight from middle; not distinctly wider than elytra. Elytra very finely and irregularly submuricately punctate and without sutural row of large punctures. Abdomen above similarly punctured, beneath more distinctly and with numerous large bluntly muricate punctures on the apical segments. Eighth tergite of male slightly produced into a rounded lobe; eighth sternite with a shallow triangular notch nearly twice as wide as long, with apex broadly rounded, and lateral angles not very distinct. Eighth tergite of female 4-lobed, the median pair narrower, equal to the laterals, and separated nearly to base; eighth sternite broadly rounded, with a single series of silken hairs.

*Type locality*.—Canada.

*Lectotype*.—Acad. Nat. Sci. Phila. no. 3138, from "Can."

*Localities represented*.—The present collection contains specimens from the following localities: Massachusetts, New York, New Jersey, Pennsylvania, Maryland, West Virginia, Michigan, Indiana, Illinois, Iowa, Nebraska, Manitoba. The Horn collection contains also a specimen from Oklahoma.

*Remarks*.—The extent of the scutellar spot is variable. It may become so large as to cover the entire width of the elytra in basal fourth and even enlarge posteriorly again along the margin.

**TACHYPORUS SNYDERI, new species**

Form robust and convex. Black; antennae, trophi, legs, prothorax, and elytra testaceous; elytra indefinitely marked with black at the scutellum and along the suture, with an indefinite humeral stripe extending for two-thirds the length and an indefinite spot near the suture just behind the middle. Antennal segments all longer than wide, eleventh almost twice as long as the tenth, expanded and obliquely truncated. Third segment of maxillary palpi feebly expanded, fourth two-thirds as long, acicular. Pronotum with sides nearly straight from basal third; not wider than elytra. Elytra irregularly but not closely punctured, each puncture excavated behind; no sutural series of larger punctures, lateral series of three punctures, and with an additional discal puncture near the humerus. Abdomen above more regularly punctate than elytra, but similarly excavated; below more coarsely punctured and with an apical series of six or eight large muricate punctures along the posterior border of segments 5 to 8. Eighth tergite of male evenly rounded; eighth sternite with triangular notch, about as wide as deep. Eighth tergite of female 4-lobed, the median pair narrower and separated only two-thirds to base; eighth sternite broadly rounded and with a single series of silken hairs.

*Type locality*.—Jacksonville, Fla.

*Types*.—Holotype (a male from Jacksonville, Fla., taken with *Reticulitermes* sp. by Dr. T. E. Snyder) and 3 paratypes, U.S.N.M. no. 50889; 1 paratype in collection of the writer. Paratypes from Alabama (Selma), Washington, D. C., and Kentucky (Henderson).

*Remarks*.—The color pattern of this species is quite distinct and is constant on the four specimens available. The paucity of material is probably due to lack of collecting rather than to rarity of the species.

**TACHYPORUS TEMACUS, new species**

Form robust and convex. Piceous-black; antennae, trophi, prothorax, elytra, and legs testaceous; elytra darker at suture and humeral margin, with median sutural spot; apex of abdominal

segments paler. Antennae with all segments longer than wide, eleventh less than one-half longer than tenth. Third segment of maxillary palpi moderately enlarged, fourth distinctly conical but acicular. Pronotum with sides nearly straight in apical two-thirds; not distinctly wider than elytra. Elytra very finely but rather evenly submuricately punctured; without sutural series, marginal series of four punctures; and with additional discal puncture near humerus. Abdomen above very indistinctly punctured; beneath a little more coarsely than elytra, with numerous large bluntly muricate punctures on the apical segments. Eighth tergite of male rounded; eighth sternite triangularly notched, the notch a little wider than deep, apex broadly rounded, angles distinct. Eighth tergite of female 4-lobed, the lobes about equal in length, the median pair narrower and separated almost to base; eighth sternite broadly rounded, with a single series of silken hairs.

*Type locality*.—Buena Vista, Colo.

*Types*.—Holotype (a male from Buena Vista, Colo., 4-7, collection of Hubbard and Schwarz) and 2 paratypes, U.S.N.M. no. 50890; 1 paratype in collection of the writer; paratypes from Colorado (Red Cliff), Nevada (Lake Tahoe), and Saskatchewan (Swift Current).

*Remarks*.—This species also probably owes its rarity to lack of collecting. It has been found only at considerable altitudes.

#### TACHYPORUS JOCOSUS Say

1834. *Tachyporus jocosus* SAY, Trans. Amer. Phil. Soc., vol. 4, p. 466.

1840. *Tachyporus arduus* ERICHSON, Genera et species staphylinorum . . . , p. 237.

1877. *Tachyporus jocosus* Say, HORN, Trans. Amer. Ent. Soc., vol. 6, p. 104.

Form robust and convex. Rufotestaceous, head darker; base of antennae, trophi, prothorax, elytra, and legs generally paler. Antennal segments expanded from the sixth but all longer than wide, last about one-half longer than the tenth. Third segment of maxillary palpi enlarged throughout its length but more apically, fourth segment acicular but short and a little larger at base. Pronotum with sides arcuate throughout; not distinctly wider than elytra. Elytra very finely and rather irregularly submuricately punctured, without sutural series. Abdomen above more sparsely punctured, beneath more coarsely and with a few of the large bluntly muricate punctures on the apical segments. Eighth tergite of male prominently evenly rounded; eighth sternite triangularly notched, notch a little wider than deep with the apex narrowly rounded, angles rounded. Eighth tergite of female 4-lobed, lobes equal in length; the middle lobes narrower and separated nearly to base; eighth sternite prominently evenly rounded, with a single series of silken hairs.

*Type locality.*—Indiana.

*Localities represented.*—The present collection contains specimens from the following localities: New Hampshire, Massachusetts, New York, New Jersey, Pennsylvania, District of Columbia, Virginia, North Carolina, Florida, Alabama, Mississippi, Ohio, Michigan, Illinois, Wisconsin, Lake Superior, Iowa, Missouri, Kansas, Texas, North Dakota, Colorado, Wyoming, New Mexico, Montana, Utah, Nevada, Idaho, California, Oregon, Washington, Saskatchewan, Ontario, British Columbia, Yukon Territory.

*Remarks.*—In Horn's system this species was not separable from his *chrysomelinus*. His series contains at least two species, besides a specimen of *elegans*. This is the most uniformly pale species and can generally be told by this character. It has a wider range than any other American member of the genus.

#### TACHYPORUS PULCHRUS Blatchley

1910. *Tachyporus pulchrus* BLATCHLEY, Coleoptera or beetles of Indiana, p. 447.

*Original description.*—"Reddish-yellow, strongly shining. Head, basal fourth of thorax, basal half or two-thirds of elytra and last two segments of abdomen, black; under surface piceous. Elytra without visible punctures, very sparsely and finely pubescent. Length 3 mm."

*Type locality.*—Indiana.

*Remarks.*—This species has only been recorded once. If the description of the color of the thorax and elytra is correct, it is quite distinct from any other species. No specimens are available to me, and I have assumed the absence of the sutural series of punctures. I believe it is the only species of *Tachyporus* described as having the base of the pronotum black and the apex pale. This is certainly not the same as *obtusius* Linnaeus of Europe, which has the pronotum entirely pale.

#### TACHYPORUS OREGONUS, new species

Form robust and convex. Piceous-black; antennae, trophi, prothorax, and elytra testaceous, legs somewhat darker; pronotum with indefinite darker spot at middle, and elytra with large scutellar spot extending to apical three-fourths and a narrow humeral stripe nearly black. Antennae with segments all longer than wide, terminal not quite twice as long as tenth. Third segment of maxillary palpi scarcely dilated, fourth acicular. Pronotum with sides nearly straight in apical half; not distinctly wider than elytra. Elytra finely submuricately punctured, the punctures frequently grouped into transverse rows of two or three; without sutural series; marginal series of four punctures, and with an additional discal punc-

ture near the humerus. Abdomen above less finely and more regularly punctured than elytra, penultimate segment with transverse row of larger punctures; beneath as above, with numerous large bluntly muricate punctures on the apical segments. Male unknown. Eighth tergite of female 4-lobed, the median incisure two-thirds as deep as laterals, median lobes narrow, lateral triangular, equal in length; eighth sternite broadly rounded, with a single series of silken hairs.

*Type locality*.—Oregon.

*Types*.—Holotype (a female from Oregon collected by C. V. Riley) and 5 paratypes, U.S.N.M. no. 50892; 1 paratype in collection of the writer. Paratypes from Oregon (Corvallis, Scio, Klamath County) and California (Eureka).

*Other specimens*.—One other specimen from Placer County, Calif., is assigned to this species. It has the pronotum not distinctly clouded and the elytral spot less definite and regular.

#### TACHYPORUS ACAUDUS Say

1834. *Tachyporus acaudus* SAY, Trans. Amer. Phil. Soc., vol. 4, p. 467.

1866. *Tachyporus maculicollis* LeCONTE, Proc. Acad. Nat. Sci. Philadelphia, vol. 18, p. 374.

1877. *Tachyporus chrysomelinus* var. *maculicollis* LeConte, Horn, Trans. Amer. Ent. Soc., vol. 6, p. 126.

*Tachyporus heterocerus* LeCONTE, MS.

*Tachyporus angusticollis* FAUVEL, MS.

Form robust and convex. Piceous; antennae, trophi, prothorax, elytra, and legs testaceous; apical half of antennae fuscous; pronotum clouded at middle. Antennal segments all longer than wide, eleventh not quite twice as long as tenth. Third segment of maxillary palpi feebly enlarged, fourth acicular and more than half as long as third. Pronotum with sides straight in apical half; not distinctly wider than elytra. Elytra very finely, irregularly, and indistinctly submuricately punctured; without sutural series; lateral series variable but with an additional discal puncture near humerus. Abdomen above more distinctly and regularly punctured, the punctures excavated behind; beneath punctures still coarser, and with numerous large bluntly muricate punctures on the apical segments. Eighth tergite of male produced into an obtusely rounded lobe; eighth sternite triangularly notched, the notch a little wider than long, the apex rounded, angles distinct. Eighth tergite of female 4-lobed, the median pair narrower and separated two-thirds to base; eighth sternite rounded and with a single series of silken hairs.

*Type locality*.—Quebec, Canada.

*Localities represented*.—The following localities are represented in the present collections: Massachusetts, Connecticut, New York,

Kentucky, Michigan, Wisconsin, Nebraska, Iowa, Kansas, Texas, New Mexico, Wyoming, Washington, Ontario.

*Remarks.*—The species named *maculicollis* by LeConte seems to have been valid and not a variety of *chrysomelinus* as thought by Horn. It was previously described by Say as *acaridus*. Both names appear to be available, so the earlier one must be used.

**TACHYPORUS ARIZONICUS, new species**

Form robust and convex. Piceous; antennae, trophi, prothorax, elytra, and legs testaceous; distal half of antennae fuscous; pronotum clouded at middle; elytral suture and margin indefinitely darker. Antennal segments all longer than wide, terminal less than one-half longer than tenth. Third segment of maxillary palpus feebly dilated, fourth conical but acicular. Pronotum with sides straight in apical half; not wider than elytra. Elytra exceedingly finely and rather densely punctate; without sutural series of large punctures; marginal series of three punctures; with additional discal puncture near humerus. Abdomen above indistinctly punctured; beneath a little more distinctly, and with numerous of the large bluntly muricate punctures on the apical segments. Eighth tergite of male narrowly rounded; eighth sternite triangularly notched, the notch two-thirds wider than deep, apex not rounded, angles obsolete. Eighth tergite of female 4-lobed, the median pair a little longer and separated to base; eighth sternite rounded and with a single series of silken hairs.

*Type locality.*—Chiricahua Mountains, Ariz.

*Type.*—Holotype (a male from Chiricahua Mountains, Arizona, 11-6, collection of Hubbard and Schwarz) and 8 paratypes, U.S.N.M. no. 50893; 12 paratypes in collection of the writer; paratypes from Arizona (Chiricahua Mountains, Santa Rita Mountains, and Nogales).

*Remarks.*—The coloration of this species is very similar to that of several others. It is best separated by the elytral punctures. It has not been seen from outside of Arizona.

**TACHYPORUS ALLENI, new species**

Form robust and convex. Piceous; trophi, prothorax, elytra, and legs testaceous; pronotum clouded at center, elytra vaguely darker about scutellum. Third segment of maxillary palpi moderately expanded, fourth acicular. Pronotum with sides straight in apical half; not wider than elytra. Elytra very finely, irregularly, and somewhat indistinctly punctate, the punctures excavated behind; without sutural series; lateral series of four punctures, and with an additional discal puncture near the humerus. Abdomen above more

regularly and evenly punctured; beneath more strongly excavated, and with numerous large bluntly submuricate punctures on the apical segments. Eighth tergite of male feebly obtusely triangular but rounded; eighth sternite rather strongly triangularly notched, the notch about as wide as deep with the angles narrowly rounded. Eighth tergite of female equally 4-lobed, the median pair narrower and separated to base; eighth sternite broadly rounded but very minutely notched at center, series of silken hairs apparently continuous.

*Type locality*.—Oswego, Clackamas County, Oreg.

*Types*.—Holotype (a male from Oswego, Oreg., collected by J. A. Allen, George M. Greene collection) and 1 paratype (same data), U.S.N.M. no. 50894; 1 paratype (same data) in collection of the writer.

*Remarks*.—The three specimens all lack both antennae. They are very similar to the specimens assigned to Sharp's species *mexicanus* from northeastern Mexico.

#### TACHYPORUS MEXICANUS Sharp

1883. *Tachyporus mexicanus* SHARP, *Biologia Centrali-Americana*, vol. 1, pt. 2, p. 311, pl. 7, fig. 12.

Form robust and convex. Piceous; antennae, trophi, prothorax, elytra, and legs testaceous; distal half of antennae infuscate; pronotum clouded at center, elytra with humeral stripe clouded. Antennal segments all longer than wide, eleventh less than twice as long as the tenth. Third segments of maxillary palpi feebly enlarged, fourth acicular. Pronotum smooth, shining, impunctate; sides straight in apical half; not wider than the elytra. Elytra very finely and irregularly submuricately punctured, punctures frequently arranged in transverse groups; without sutural series; lateral series of four punctures; and with an additional discal puncture near the humerus. Abdomen above punctured a little less finely and more sparsely and regularly than elytra; beneath similarly but with numerous of the large bluntly submuricate punctures on the apical segments. Eighth tergite of male rather narrowly rounded; eighth sternite triangularly notched, notch a little wider than deep, apex rounded, the angles rather obsolete. Eighth tergite of female 4-lobed, the median pair narrowly separated only two-thirds to base; eighth sternite with an exceedingly feeble emargination at middle, but with a single continuous series of silken hairs.

*Type locality*.—Saltillo, in Coahuila, Mexico.

*Other specimens*.—One specimen each from northern Mexico and western Texas have been tentatively assigned to this species. They do not carry any other data.



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## REVISION OF THE FISHES OF THE FAMILY MICRODESMIDAE, WITH DESCRIPTION OF A NEW SPECIES<sup>1</sup>

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GÜNTHER described and figured the genotype of *Microdesmus* (*dipus*), a specimen  $4\frac{1}{2}$  inches in length, collected on the Pacific coast of Panama by Capt. J. M. Dow. This example, now in the British Museum, remained the sole representative of the genus until the appearance of *M. retropinnis* Jordan and Gilbert, based on an example nearly 4 inches in length, taken in a rocky tide pool at Panama, early in the spring of 1881, by Dr. Charles H. Gilbert. The genus *Cerdale* appeared in the same paper following the description of *M. retropinnis* but was disassociated from *Microdesmus* on characters that at that time seemed sound when one considers the limited material at hand. Weymouth, in 1911, described an extremely elongate form, creating for it the genus *Leptocerdale*, the first of the group to be recorded from the Atlantic. This specimen, 210 mm long, was taken June 11, 1906, at the outlet of Calcasien Lake, near Cameron, La., by H. M. Spaulding. In 1927 Chabanaud described the first species to be recorded from the Old World, under the name *Leptocerdale aethiopicum*. The type, 51 mm in length, was taken at Malimba Bay, Kwele-Kwele Island, in Douala Bay, Cameroons. In 1928 Meek and Hildebrand described and figured three new species of *Microdesmus*, overlooking a fourth undescribed form from material

<sup>1</sup> Since this paper went to press, an additional species, *Cerdale bilineatus* Clark (Proc. California Acad. Sci., ser. 4, vol. 21, no. 29, p. 394, Aug. 12, 1936), apparently referable to the Microdesmidae, has been described from Indefatigable Island.



collected at Chame Point, Panama, by Robert Tweedlie. *Cerdale floridana* Longley was described in 1934 from several specimens collected at Tortugas, Fla., in water not exceeding 10 fathoms in depth. Five of these specimens are deposited in the National Museum collections, and they represent the smallest species of the genus so far reported.

Unfortunately, the types of *Cerdale ionthas* Jordan and Gilbert and of *Microdesmus retropinnis* Jordan and Gilbert were never received at the National Museum, although they are recorded as having been deposited there. *M. retropinnis* is represented in the National Museum collections by two examples, 85 and 99 mm in length, collected in rocky tide pools at Chame Point, Panama. Of *Cerdale ionthas* we have two specimens from Panama, one collected by Gilbert and the other by Tweedlie.

The National Museum received a specimen of *Microdesmus* on June 10, 1935, from Prof. Manuel Valerio, formerly director, Museo Nacional, San José, Costa Rica. It was labeled "S. Lucas", and I assume that it was collected on the Pacific coast of the Isthmus by the donor. This specimen, 59 mm in standard length, proved to be *Microdesmus dipus* Günther, the second record of this rare fish. Comparison of this specimen with the "*Microdesmus dipus*" of Meek and Hildebrand shows that the latter was erroneously identified, a fact not wholly unsuspected by these authors.

Careful study of the material before me shows conclusively that *Cerdale* Jordan and Gilbert and *Leptocerdale* Weymouth are without generic value, merely representing extreme specific variations within the genus *Microdesmus*. Since *Cerdale* falls as a synonym of *Microdesmus*, the family name Cerdalidae must be changed to Microdesmidae.

Our material shows conclusively that the characters of the branchial openings, chiefly relied upon for differentiating between *Cerdale* Jordan and Gilbert, *Leptocerdale* Weymouth, and *Microdesmus* Günther, are without generic value, being perfectly graduated between *M. floridanus* on the one hand and *M. longipinnis* on the other. The point of origin of the dorsal fin is likewise specific, *M. aethiopicus* being intermediate between *M. ionthas* and *M. retropinnis*. The genotype, *M. dipus*, is intermediate between *M. ionthas* and *M. longipinnis* in all important external characters as well as the number of vertebrae.

It is evident from the wide distribution of the genus that only a very small percentage of the species of *Microdesmus* are known at the present time. The only species of which we have a fair series is the one having the greatest number of rays in the vertical fins, and it is

reasonable to assume that this species represents the maximum in variation of the fin-ray counts of the known species. In this series of 30 specimens the fin-ray counts are as follows, the figure in parentheses representing the number of specimens:

Dorsal fin: 73 (3), 74 (4), 75 (6), 76 (4), 77 (9), 78 (4). Anal fin: 58 (9), 59 (10), 60 (5), 61 (5). Counts of body myomeres: 19 (2), 20 (19), 21 (9). Counts of caudal myomeres: 38 (1), 39 (5), 40 (15), 41 (8), 42 (1).

The myomeric impressions are counted from the base of the pectoral fin, along flank to above vent, and to the hypural. Vertebrae counts are from X-ray photographs.

It was found impracticable to separate the counts of the vertical fin supports into spinous and soft ray sections, the difference between the anterior and posterior portions being so gradual that no definite point of differentiation can be reliably fixed.

I am indebted to Dr. George S. Myers, formerly assistant curator of fishes, United States National Museum, for valuable assistance in the preparation of the manuscript and key. The vertebral counts were made possible by courtesy of the authorities of the United States Naval Hospital and of Dr. Dirk Meindert te Groen, Lieutenant (M. C.), U. S. Navy, in charge of X-ray.

#### Genus MICRODESMUS Gunther

*Microdesmus* GUNTHER, Proc. Zool. Soc. London, 1864, p. 26. (Type, *Microdesmus dipus* Gunther.)

*Cerdale* JORDAN and GILBERT, Bull. U. S. Fish Comm., vol. 1, p. 332, 1881 (1882). (Type, *Cerdale ionthas* Jordan and Gilbert.)

*Leptocerdale* WYDMOUTH, Proc. U. S. Nat. Mus., vol. 38, p. 142, 1910. (Type, *Leptocerdale longipinnis* Weymouth.)

Body moderate or very elongate, slender, somewhat compressed. Vertebrae moderate or numerous. Head short, snout obtuse, usually with swollen longitudinal ridges or muscular folds. Mouth small, not protractile, more or less oblique. Lips thick, with pronounced flanges. Chin strongly projecting in the anterior profile, usually with longitudinal ridges. Vertical fins long and low, united with the caudal by membrane. Gill openings restricted laterally, oblique, broadly joined to the isthmus. Ventral fins closely approximated, rays I-3. Teeth in the jaws in two irregular series, absent on vomer and palatines. No cirri or filaments. Lateral line absent.

Small anguilliform fishes of tropical shores and tidepools, living in burrows in sand or mud.

## KEY TO THE SPECIES OF MICRODESMUS

- a*<sup>1</sup>. Vent situated in posterior half of standard length.
- b*<sup>1</sup>. Upper angle of gill opening opposite lower pectoral rays.
- c*<sup>1</sup>. Dorsal 41 to 44; anal 26 to 29.....*ionthas*
- c*<sup>2</sup>. Dorsal 45 to 47; anal 30 to 33.....*floridanus*
- b*<sup>2</sup>. Upper angle of gill opening opposite or above base of middle pectoral rays.
- d*<sup>1</sup>. Origin of dorsal fin less than one head-length behind head.
- e*<sup>1</sup>. Dorsal fin supports 47; anal fin supports 26 to 30; origin of dorsal fin about two-thirds head-length behind tip of appressed pectoral.....*aethiopicus*
- e*<sup>2</sup>. Dorsal fin supports 55 or more; anal fin supports 34 or more; origin of dorsal above or before tip of appressed pectoral.
- f*<sup>1</sup>. Dorsal fin supports 55; anal fin supports 34.....*dipus*
- f*<sup>2</sup>. Dorsal fin supports 69; anal fin supports 43.....*affinis*
- d*<sup>2</sup>. Origin of dorsal fin at least two head-lengths behind head.....*retropinnis*
- a*<sup>2</sup>. Vent situated in anterior half of standard length.
- b*<sup>1</sup>. Body moderately elongate, head contained 8 to 13 times in standard length; depth of body 10 to 20.
- c*<sup>1</sup>. Predorsal region contained 5 to 7 times in standard length; dorsal 55 to 67; anal 38 to 48.
- d*<sup>1</sup>. Depth about 20, preventral 10; dorsal 55; anal 38.....*hildebrandi*
- d*<sup>2</sup>. Depth 10 to 11, dorsal 67; anal 48.....*intermedius*
- c*<sup>2</sup>. Predorsal 8 to 9 times in standard length, dorsal 76; anal 58.....*multiradiatus*
- b*<sup>2</sup>. Body very elongate, head contained about 15 to 17 times in standard length; depth 28 to 34.....*longipinnis*

## MICRODESMUS IONTHAS (Jordan and Gilbert)

FIGURE 9, *b*; FIGURE 10, *a*; PLATE 2, FIGURE 1

*Cerdale ionthas* JORDAN and GILBERT, Bull. U. S. Fish Comm., vol. 1, p. 332, 1881 (1882) (Panama Bay).—JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 3, p. 2449, 1898 (Panama).—GILBERT and STARKS, Mem. California Acad. Sci., vol. 4, p. 196, pl. 31, fig. 58, 1904 (Panama Bay).

Body comparatively short, of nearly equal depth throughout, strongly compressed posteriorly. Lower jaw strongly projecting, with a small fleshy lump at the symphysis. Head 7.2 in standard length; depth 8.5 to 9.2; predorsal 4.9 to 5.1; preanal 1.6 to 1.9; caudal 2.2 to 2.4; preventral 7.2; base of ventrals to vent 2.6 to 2.9; snout 5.4 to 5.9 in head, measured to upper end of gill opening; interorbital 4.2 to 4.3. Dorsal 41 to 44; anal 26 to 29; pectoral 12; ventral I-3. Eye comparatively large, lateral, about equal to length of snout; mouth small, oblique, not quite reaching to anterior edge of eye; lips not notably fleshy, the lateral flanges small and inconspicuous; longitudinal ridges of snout and lower jaw well developed. Teeth very small, close-set, in two irregular series in the jaws, vomer and palatines toothless. Gill openings restricted laterally, the upper end in front of lower pectoral ray, the aperture extending obliquely

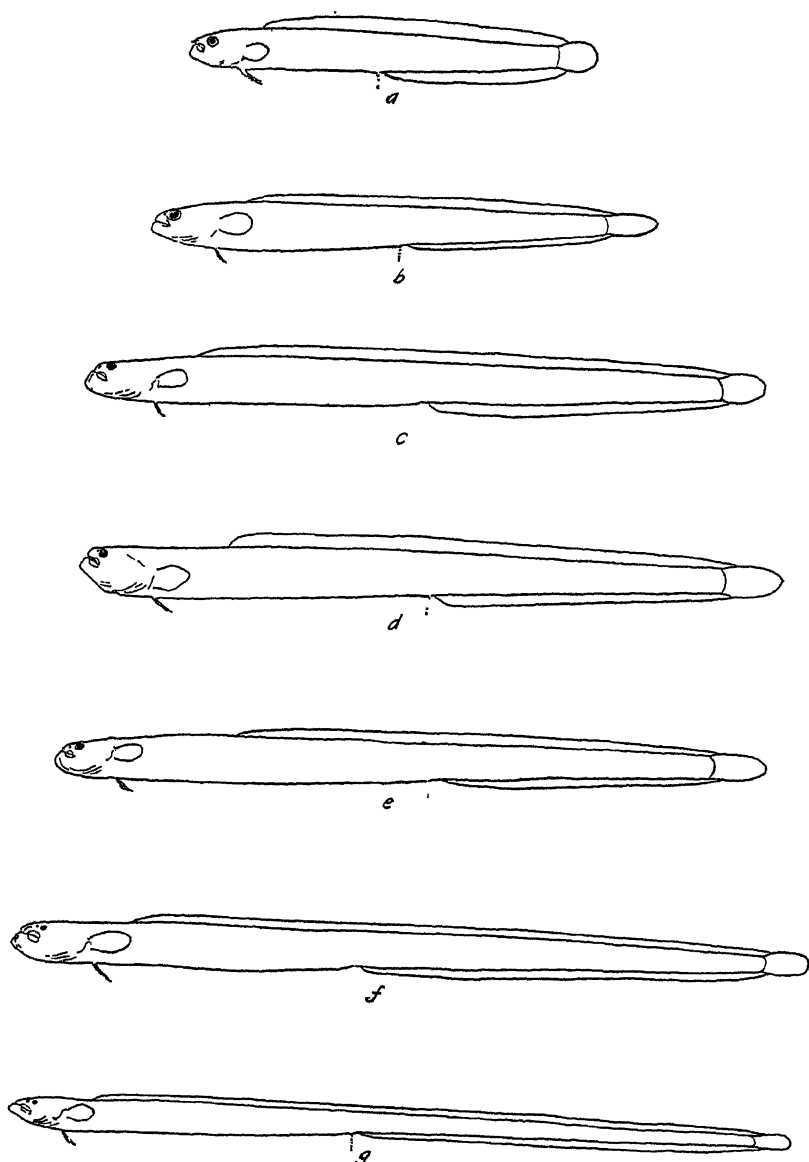


FIGURE 9.—a, *Microdesmus floridanus* (Longley), outline drawing of the type, natural size; b, *M. ionthas* (Jordan and Gilbert), outline drawing, natural size; c, *M. dipus* Günther, outline drawing,  $\times 1.5$ ; d, *M. aethiopicus* (Chabanaud), outline drawing of the author's figure, natural size; e, *M. retropinnis* Jordan and Gilbert, outline drawing, natural size; f, *M. hildebrandi*, new species, outline drawing of the type, natural size; g, *M. longipinnis* (Weymouth), outline drawing of paratype, one-half natural size.

downward and forward about as in related species to a point well below and before the base of the fin, the opening about half width of the pectoral base. Origin of dorsal fin above posterior third of the appressed pectoral, the fin of medium height and joined to the caudal by membrane. Anal similar to dorsal, but much shorter, joined to caudal by membrane. Scales very small, covering body and head except snout and lower jaw, the rows of scales at the base of the dorsal and anal fins diverging outward and backward on a narrow flat plane the full length of the fin base. Scales with 33 radiating striae. Myomeres conspicuous, 19 body and 22 caudal=41 muscular impressions. Vertebrae, 20 body and 22 caudal=42. Color brownish above, pale below, the head and sides with small dark-brown spots, these forming faint dark bars under the lower jaw, the dorsal fin with faint dark spots, an indication of faint dark bars radiating from the eye.

Two specimens, 51 and 65.5 mm in standard length, the smaller from Panama Reef, collected by Meek and Hildebrand; the larger example from a tide pool at Panama, taken by Dr. Charles H. Gilbert. U.S.N.M. nos. 50396 and 82677.

This species is close to *M. floridanus* (Longley) but differs in fin formula, gill opening, and proportional measurements. From *M. aethiopicus* it is distinguished by the smaller gill opening and more anterior insertion of the dorsal fin.

#### MICRODESMUS FLORIDANUS (Longley)

##### FIGURE 9, a; FIGURE 10, b; PLATE 2, FIGURE 2

*Cerdale floridana* LONGLEY, Carnegie Inst. Washington Year Book for 1933-1934, no. 33, p. 259, 1934 (Tortugas).

Body comparatively short, compressed, the greatest depth midway between origin of dorsal and vent; caudal portion without fin, a little shorter than rest of body, the vent situated midway between base of caudal fin and anterior margin of eye. Head 6 to 7.2 in standard length; depth 8.5 to 9.5; predorsal 4.3 to 4.9; preventral 5.9 to 6.8; base of ventrals to vent 2.6 to 2.9; preanal 1.9; caudal without fin 2.1 to 2.2. Snout short 5.5 to 7.7 in length of head, measured to gill opening; interorbital 4.7 to 6.4; eye 4.1 to 6.0. The eye is comparatively larger in the smaller examples. Dorsal 45 to 47; anal 30 to 33; pectoral 12; ventral I-3. Eye rather large, about equal to length of snout, lateral in position, iris silvery. Mouth small, little oblique, the maxillary not nearly reaching anterior edge of orbit; lower jaw projecting, with a small fleshy conical tip forming the anterior profile of the head. Lips small, restricted laterally, the free folds not passing around the mouth anteriorly. Snout and lower jaw with longitudinal ridges and muscular folds, though not so well developed as in related

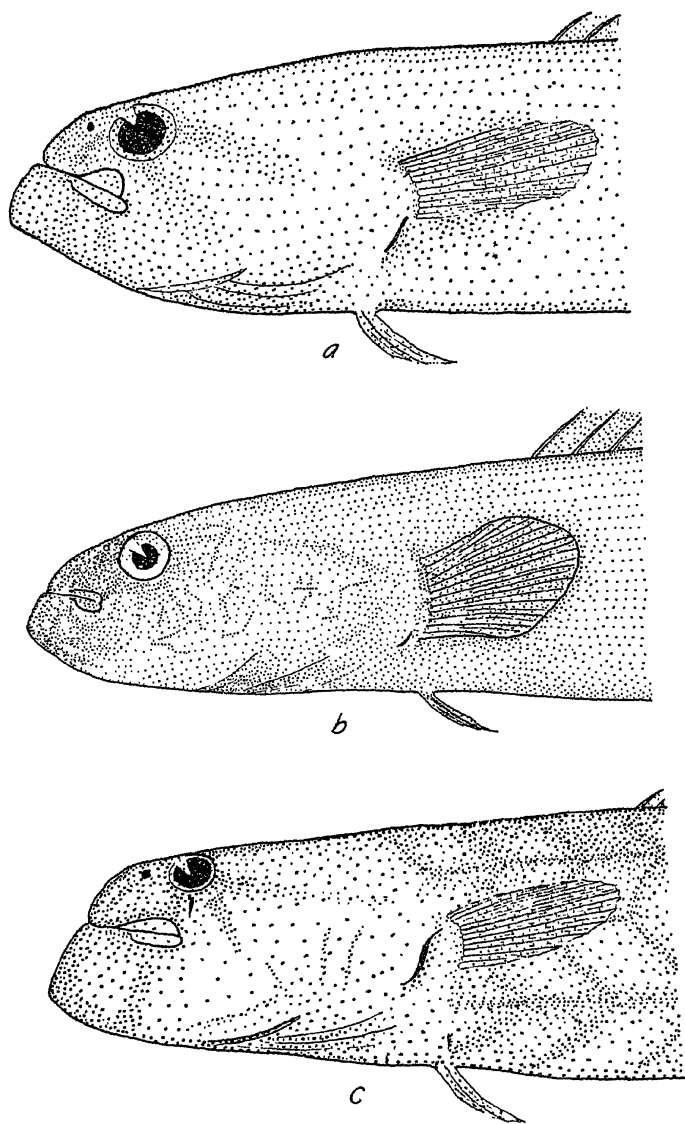


FIGURE 10.—a, *Microdesmus ionthas* (Jordan and Gilbert), detailed enlargement of head,  $\times 4$ ; b, *M. fortidanus* (Longley), detailed enlargement of head of type,  $\times 4$ ; c, *M. dipus* Günther, detailed enlargement of head,  $\times 5$ .

species. Anterior nostril in a very minute pore at the oral end of the outer frontal ridge; posterior nostril close above and before eye. Teeth very small, apparently in two irregular series in the jaws, vomer and palatines toothless. Gill openings very small, oblique, close in front of the lower pectoral ray, the length of the aperture equal to the diameter of the pupil. Body and head, except snout and lower jaw, covered with minute nonimbricate scales imbedded in the skin; rows of scales of the dorsal region following the direction of the myomeric impressions. Scales with 30 radiating striae. Myomeres evident, 20 body and 23 caudal=43 muscular impressions. Vertebrae, 20 body and 24 caudal=44. Origin of dorsal above posterior third of the appressed pectoral, the fin long and moderately high, attached to caudal fin at base by membrane; anal similar but much shorter, attached to caudal by membrane. Ventrals small, close together, situated directly below pectoral base. Color pale straw, fins immaculate, back and sides above with small dark-brown freckles evenly and uniformly distributed, lower flank and belly lighter straw.

Five examples from Tortugas, Fla. Standard length 38.4 to 60 mm, of which the type, U.S.N.M. no. 102050, is the largest. Collector, Dr. W. H. Longley.

This species is distinguished from *M. ionthas* (Jordan and Gilbert) by the smaller gill openings, number of rays in the vertical fins, and proportional measurements. From *M. aethiopicus* (Chabanaud) it is distinguished by the more anterior insertion of the dorsal fin and by the much smaller gill opening.

MICRODESMUS AETHIOPICUS (Chabanaud)

FIGURE 9, d

*Leptocerdale aethiopicum* CHABANAUD, Bull. Mus. Hist. Nat., vol. 33, no. 3, pp. 230-234, 1927; Bull. Soc. Zool. France, vol. 53, pp. 279-285, figs. 1-4, 1928 (Cameroons).

Body elongate, compressed, the caudal portion without fin shorter than rest of body, the vent situated about midway between the occiput and base of caudal fin. Head 10 percent of total length; depth 6.4; predorsal 21; preanal 54; preorbital from anterior border of eye to tip of mandible 25 percent of length of head; diameter of eye 12; interorbital 8; length of pectoral 50; ventral 46; caudal fin 100. The diameter of the eye is contained slightly more than twice in the distance between the eye and the tip of the lower jaw. Thickness of the body at the base of the pectoral fins 83 percent of the depth of the body at the same point; depth at base of caudal fin 41. Dorsal 47; anal 26; pectoral 12; ventrals 4. Origin of the dorsal fin about one head-length behind the occiput, or at a point behind the tip of the snout equal to half the length of the base of the anal fin. Vertical

fins joined to caudal by membrane. Ventral fins small, close together, situated opposite base of the pectorals. Gill openings small, restricted laterally, the upper angle attached opposite the base of the third pectoral ray, the opening extending obliquely downward and forward at an angle of  $45^\circ$  with the axis of the body to a point below and in front of the lower pectoral ray, the aperture about equal to width of the pectoral base. Body and head, except snout and lower jaw, covered with minute nonimbricate scales imbedded in the skin. Color light brown, the upper surface with small dark spots and reticulations, the spots forming dark bands on the body that extend well down on the flank following the course of the myomeric impressions.

Type taken at Malimba Bay, Kwele-Kwele Island, in Douala Bay, Cameroons. Total length 51 mm. Paratype from near same locality.

This species differs from *M. ionthas* (Jordan and Gilbert) and from *M. floridanus* (Longley) in the more posterior insertion of the dorsal fin and larger gill openings.

MICRODESMUS DIPUS Günther

FIGURE 9, c; FIGURE 10, c; PLATE 2, FIGURE 3

*Microdesmus dipus* GÜNTHER, Proc. Zool. Soc. London, 1864, p. 26, pl. 3, fig. 2 (Panama).—LOCKINGTON, Proc. Acad. Nat. Sci. Philadelphia, 1881, p. 114 (La Paz, Lower California).—JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, pt. 3, p. 2450, 1898 (Panama).—GILBERT and STARKS, Mem. California Acad. Sci., vol. 4, p. 195, 1904 (name only).

Body comparatively short, of about equal depth throughout, somewhat compressed posteriorly. Lower jaw projecting, with a small inconspicuous fleshy lump at the symphysis. Caudal portion of body little shorter than rest of body, the vent about midway between base of caudal fin and posterior border of eye, or slightly nearer base of fin. Head 9.2 in standard length; depth 14.7; predorsal 6.3; preanal 1.8; caudal without fin 2.3; preventral 9.3; base of ventrals to vent 2.2; snout 6.4 in head measured to upper end of gill opening; interorbital 8. Dorsal 55, anal 34, pectoral 12, ventral I-3. Eye small but larger than in related species, about equal to length of snout, high and lateral. Mouth small, little oblique, the gape not reaching anterior border of the eye. Lower jaw and snout with well-defined longitudinal ridges. Lips thin, with small flanges laterally, the lower slightly larger; anterior nostril a small round pore at the oral end of the frontal longitudinal ridges; posterior nostril porelike, above and before eye. Teeth minute, even, close-set, in two irregular series in the jaws; vomer and palatines toothless. Gill openings restricted laterally, extending from base of the fourth pectoral ray obliquely downward and forward to a point in front of lower ray of fin, the length of the opening about equal to the width



of the pectoral base. Body covered with minute scales imbedded in the skin, snout and lower jaw naked; a flat band of diverging scales follows the base of the dorsal and anal fins throughout their length, those of the dorsal region continue forward to the occiput. Scales with 22 radiating striae. Myomeres evident, 22 body and 27 caudal = 49 muscular impressions. Vertebrae, 26 body and 27 caudal = 53. Color brownish, with many small dark spots about size of pupil, the lighter ground color forming reticulations on the back, some dark shades radiating from the eye and dark bars across lower jaw, dark bars follow the course of the muscular body ridges well down on the flank; belly and fins plain, translucent.

One specimen of this rare fish from the Pacific side of the Isthmus of Panama. Collected by Prof. Manuel Valerio. Length 59 mm. U.S.N.M. no. 101379.

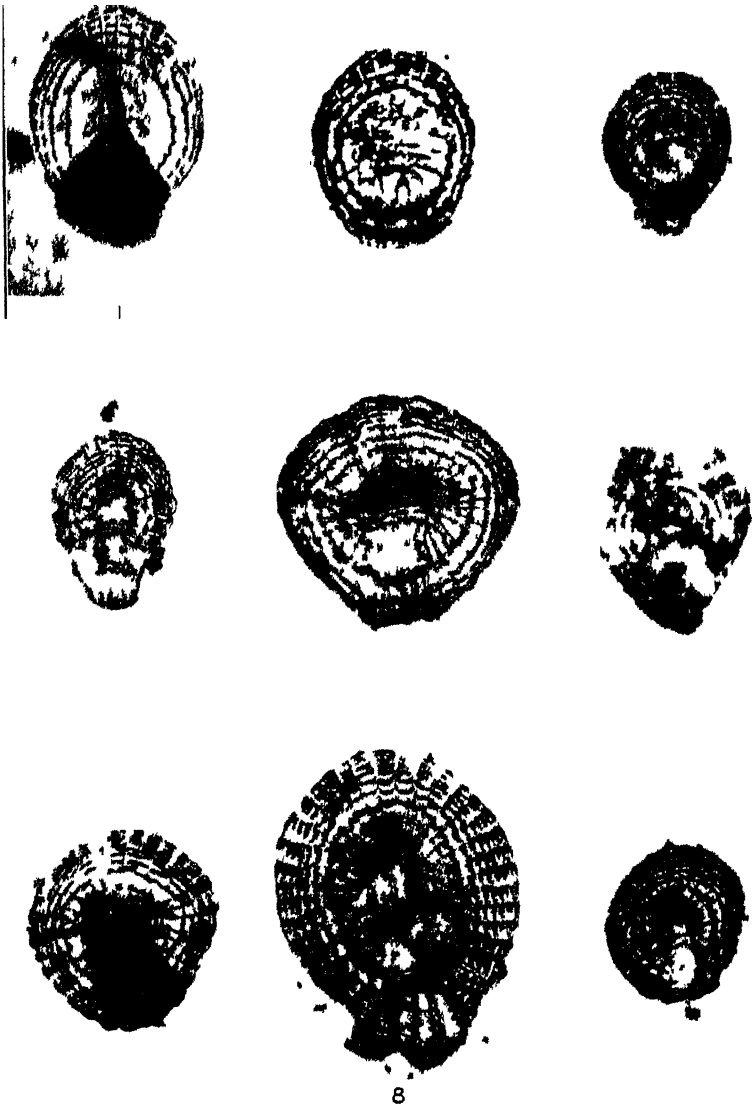
This species is most closely related to *M. hildebrandi*, new species, differing notably in the position of the vent and in fin-ray and myomeric counts.

*MICRODESMUS AFFINIS* Meek and Hildebrand

FIGURE 11, a; PLATE 2, FIGURE 4

*Microdesmus affinis* MEEK and HILDEBRAND, Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 3, pp. 955-6, pl. 98, fig. 1, 1928 (Chame Point, Panama).

Body elongate, of nearly equal depth throughout, somewhat compressed. Lower jaw strongly projecting with a small fleshy lump at the symphysis. Caudal without fin shorter than rest of body; vent midway between occiput and base of caudal fin. Head 10.5 in standard length; depth 16.8; predorsal 7.4; preanal 1.9; caudal 2.1; pre-ventral 10.1; base of ventral to vent 2.3; snout 5.4 in head, measured to upper end of gill opening; interorbital 7.7. Dorsal 69, anal 43, pectoral 12, ventrals I-3. Eye rather small, high, not fully lateral, the upper rim leaning a little to the median line, 1.7 in snout; mouth small, little oblique, the gape about reaching anterior border of the eye; snout and lower jaw with well-defined longitudinal ridges. Lips thin, with small lateral flanges, the lower of which is slightly the larger; nostrils placed as in related species. Teeth small, close-set in two series in the jaws, none on the palatines or vomer. Gill openings restricted laterally, extending from base of middle pectoral rays obliquely downward and forward to below lower ray of fin, length of the opening about equal to width of pectoral base. Dorsal and anal fins long and low, similar, though the latter much shorter, both fins joined to the caudal at base; origin of dorsal above posterior third of the pectoral length. Body covered with minute scales as in related species, snout and lower jaw naked. Scales with 19 radiating striae. Myomeres evident, 30 body and 33 caudal = 63 muscular impressions. Vertebrae, 28 body and 34 caudal = 62. Color uniform olivaceous, fins translucent, caudal slightly darker.

SCALES OF MICRODESMUS  $\times 80$ 

- 1, *M. ionthas* (Jordan and Gilbert), 2, *M. floridanus* (Longley), from the type, 3, *M. dipus* Gunther, 4, *M. affinis* Meek and Hildebrand, from the type, 5, *M. retropinnis* Jordan and Gilbert, 6, *M. hildebrandi*, new species, from the type, 7, *M. intermedius* Meek and Hildebrand, from the type, 8, *M. multiradiatus* Meek and Hildebrand, from the type, 9, *M. longipinnis* (Weymouth) from a paratype



One example 98 mm in standard length. Collected at Chame Point, Panama, by Robert Tweedlie. U.S.N.M. no. 84300 (type).

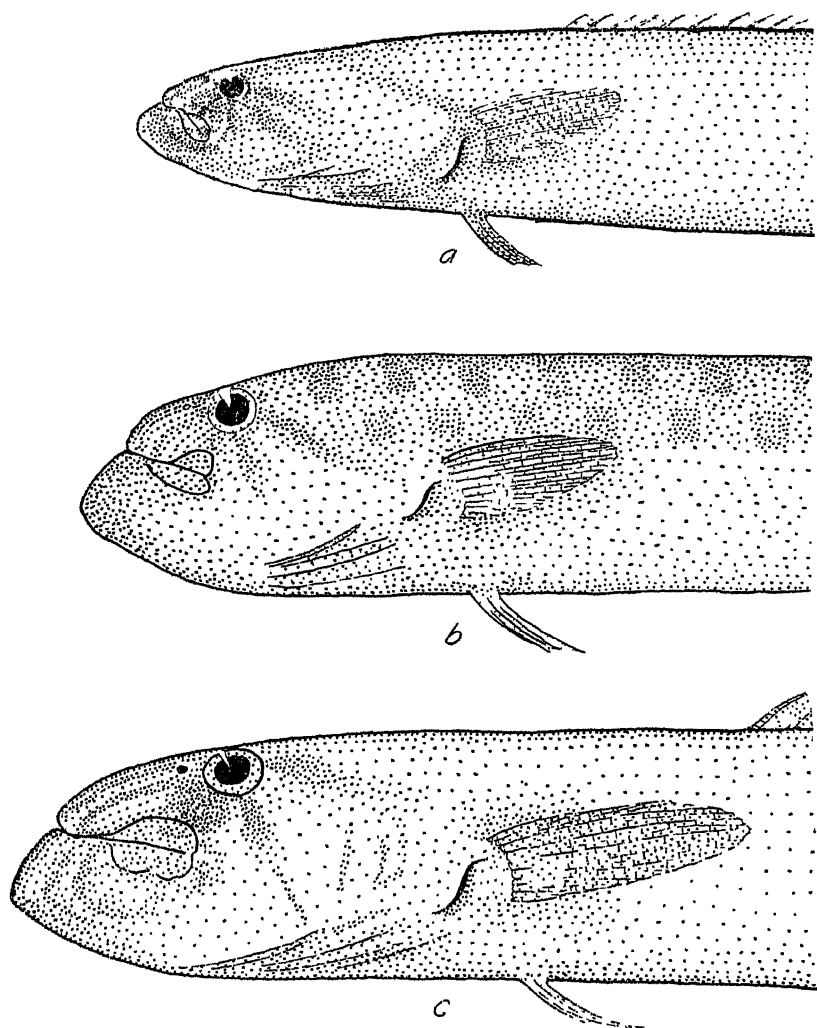


FIGURE 11.—a, *Microdesmus affinis* Meek and Hildebrand, detailed enlargement of head of type,  $\times 3$ ; b, *M. retropinnis* Jordan and Gilbert, detailed enlargement of head,  $\times 4$ ; c, *M. hildebrandi*, new species, detailed enlargement of head of type,  $\times 4$ .

This species seems most closely related to *M. longipinnis* (Weymouth), agreeing in the number of body and caudal vertebrae as well as fin-ray counts; the difference in position of the vent, as well as proportional measurements, is very pronounced.

## MICRODESMUS RETROPINNIS Jordan and Gilbert

FIGURE 9, e; FIGURE 11, b; PLATE 2, FIGURE 5

*Microdesmus retropinnis* JORDAN and GILBERT, Bull. U. S. Fish Comm., vol. 1, p. 331, 1881 (1882) (Panama).—JORDAN and EVERMANN, U. S. Nat. Mus. Bull. 47, p. 2450, 1898.—GILBERT and STARKS, Mem. California Acad. Sci., vol. 4, p. 195, pl. 31, fig. 59, 1904 (Panama).—MEEK and HILDEBRAND, Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 3, p. 955, 1928 (Panama).

Body moderately elongate, somewhat compressed posteriorly, the caudal portion, without fin, notably shorter than rest of body. Head 11.4 to 13 in standard length; depth 10.5 to 14.4; predorsal 3.2 to 3.7; preanal 1.3 to 1.8; caudal 2.4 to 2.5; preventral 11.5 to 12; base of ventrals to vent 2 to 2.7; snout 4.8 to 5 in head measured to upper end of gill opening; interorbital 5.3 to 6.3. Dorsal 47 to 49, anal 30, pectoral 10, ventral I-3. Eye small, high, lateral; mouth small, little oblique, the gape not quite reaching anterior edge of orbit; lower jaw strongly projecting with a small fleshy prominence at the symphysis; lips with a free flange restricted laterally, the free edge of which does not pass around the mouth anteriorly. Snout and lower jaw with pronounced longitudinal swollen muscular ridges. Anterior nostril in a minute pore at the oral end of the outer frontal ridge; posterior nostril in a small round opening just before and above eye. Teeth comparatively strong, conical, in two irregular series in the jaws; no teeth on the vomer or palatines. Gill openings restricted laterally, adnate to the scapular region in front of the base of the upper fourth pectoral ray, the aperture extending obliquely downward and forward to a point in front of the lower pectoral ray, the openings not so long as the width of the base of the fin. Body and head, except snout and lower jaw, covered with minute nonimbricate scales imbedded in the skin; at the base of the vertical fins on either side of the median line of the back the arrangement of the rows of scales is notably differentiated in that the rows diverge outward and backward following the direction of the myomeric impressions. Scales with 39 radiating striae. Myomeres evident, 31 body and 26 caudal=57 muscular impressions. Vertebrae, 32 body and 25 caudal=57.

Origin of the dorsal fin more than two head-lengths behind the head, or opposite a point midway between tip of lower jaw and the vent, or a little nearer the former. Dorsal and anal fins long and low, similar, but the anal much shorter, both fins joined to the caudal by membrane. Ventrals very small, closely approximated and situated slightly behind the base of the pectorals. Color brownish above slightly paler below, upper part of sides with two longitudinal rows of quadrate dark-brown spots; the upper series united over median line of back and separated from the succeeding ones by light interspaces of the ground color, forming faint cross bars on the predorsal region,

shades of the upper row faintly invading the membrane of the base of the dorsal fin; sides of the head and lower jaw indefinitely shaded with brownish.

Two specimens, 80 and 91 mm in standard length; the smaller from a tide pool at Panama. Collected March 21, 1912, by Meek and Hildebrand. U.S.N.M. no. 82678. The larger example, no. 82705, collected at Chame Point, Panama, by Robert Tweedlie.

Distinguished from all other species of the genus by the much greater posterior insertion of the dorsal fin.

**MICRODESMUS HILDEBRANDI, new species**

FIGURE 9, *f*; FIGURE 11, *c*; PLATE 2, FIGURE 6

*Microdesmus dipus* (not Günther) MEEK and HILDEBRAND, Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 3, pp. 956-957, 1928 (Panama).

Body elongate, compressed posteriorly; tail notably longer than rest of body, its length to base of caudal fin 1.7 in total length. Head short, 10.6 in standard length. Depth 20; predorsal 6.3; preanal 2.1; preventral 10.2; ventral to vent 2.7; snout 4.9 in head measured to upper angle of gill opening. Dorsal 55, anal 38, pectoral 10, ventral I-3. Eye small, lateral, high. Interorbital rather broad, the space between the eyes 3.7 in head. Mouth small, little oblique, reaching about to anterior edge of the eye. Lower jaw strongly projecting; lips fleshy, with pronounced lateral flanges, the free margin of which is confined to the side of the head. The frontal region and lower jaw with pronounced longitudinal swollen muscular folds or ridges; the former extending from interorbital region to tip of snout; the latter from tip of lower jaw to posterior end of mandible. Anterior nostril situated in a minute round pore at the oral end of the frontal ridges; posterior nostril slightly larger and situated above and before the eye. Teeth small, even, close-set, in two irregular series in the jaws; vomer and palatines toothless. Gill openings restricted laterally, extending from base of the middle pectoral rays obliquely downward and forward to slightly below and before the lower pectoral ray, the apertures slightly longer than width of the base of pectoral fin. Body and head, except snout and lower jaw, covered with minute scales imbedded in the skin; at the base of the dorsal and anal fins the arrangement of the scales is notably differentiated in that they are imbedded in oblique rows extending outward and backward on a longitudinal narrow flat plane extending the full length of the fin bases. Scales with 24 radiating striae. Myomeres evident, 20 body and 31 caudal=51 muscular impressions. Vertebrae, 19 body and 37 caudal=56. Vertical fins long and low, confluent with the caudal fin at base. Origin of dorsal fin above tip of pectoral. Anal similar to but shorter

than dorsal. Ventral fins small, very close together and situated slightly behind base of pectorals. Vent preceded by longitudinal striations of the skin of the belly, indicating that the region is capable of some distension. Color olivaceous, fins plain, translucent, the caudal dark brown.

A single example 104 mm in standard length; taken at Chame Point, Panama, by Robert Tweedlic. U.S.N.M. no. 86547 (type).

This species is closely related to *M. dipus* Günther but differs greatly in the position of the vent, fin-ray, and myomeric counts.

I take great pleasure in dedicating this species to Dr. Samuel F. Hildebrand, ichthyologist, United States Bureau of Fisheries, in recognition of his valuable work on the fishes of Panama.

**MICRODESMUS INTERMEDIUS** Meek and Hildebrand

**FIGURE 12, a; PLATE 2, FIGURE 7**

*Microdesmus intermedius* MEEK and HILDEBRAND, Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, pt. 3, p. 957-958, fig. 2, 1928 (Panama).

Body elongate, compressed, the caudal portion, without fin, notably longer than rest of body. The body of about equal depth throughout. Head 8 to 8.4 in standard length; depth 10.3 to 13.3; predorsal 5.6 to 6.4; preanal 2.1 to 2.5; caudal 1.4 to 1.6; preventral 8 to 9.7; base of ventrals to vent 3 to 3.6. Snout 5 in head, measured to upper end of gill opening; interorbital 5 to 5.5. Dorsal 67, anal 48, pectoral 12, ventral I-3. Myomeres evident, 17 body and 34 caudal=51 muscular impressions. Vertebrae, 22 body and 33 caudal=55. Eye minute, high, about 3 in length of snout. Mouth comparatively large, the gape oblique, reaching to slightly past anterior edge of orbit. Lower jaw somewhat projecting, but less so than in related species, the fleshy projection at the symphysis little developed; lips with conspicuous free flanges restricted to the side of the jaws and not forming a free fold anteriorly. Snout and lower jaw with longitudinal grooves and ridges, the latter extending well back under the branchial region. Anterior nostril in a minute pore at the oral end of the frontal ridges; posterior nares in a small round opening above and before eyes. Teeth small, close-set, conical, apparently in two irregular series in the jaws; vomer and palatines toothless. Gill openings restricted laterally, the upper end adnate to the scapular region in front of the middle pectoral rays, the apertures extending obliquely downward and forward to a point slightly below the base of the lower pectoral ray, the opening not quite so long as the width of the fin base. Pores of the head rather small, five short vertical rows below the eye, two horizontal rows behind and below eye crossed by two vertical rows on the temporal region. A faint cross is formed by rows of minute pores on the cheek, the juncture of which is about

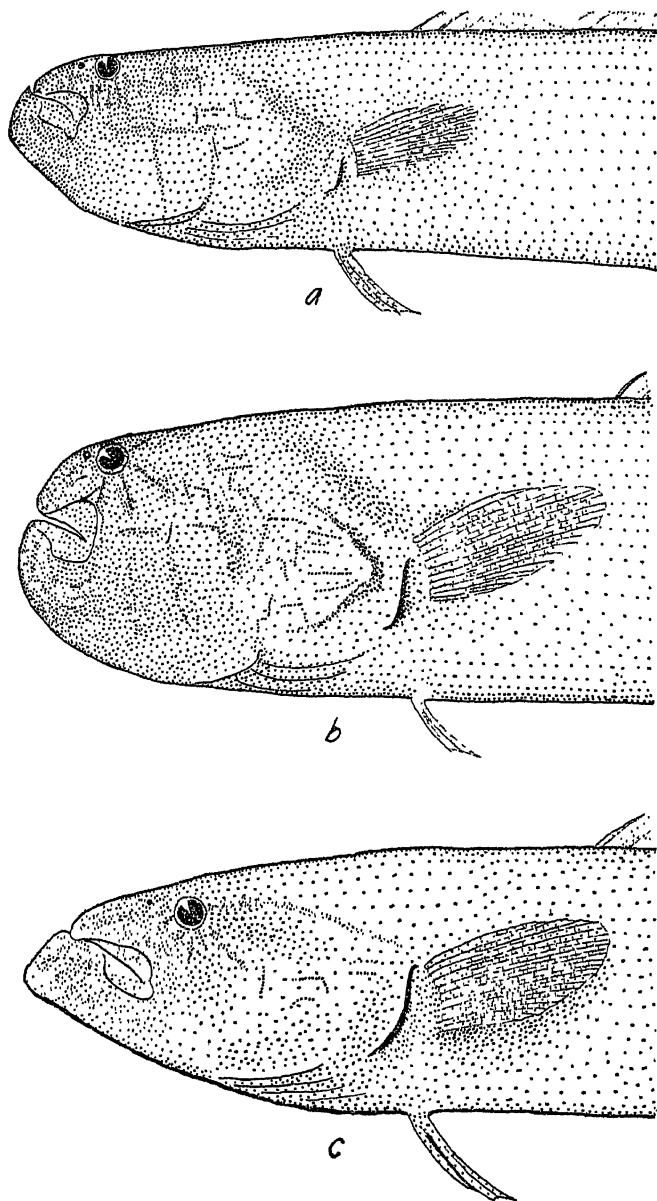


FIGURE 12.—a, *Microdesmus intermedius* Meek and Hildebrand, detailed enlargement of head of type,  $\times 3$ ; b, *M. multiradiatus* Meek and Hildebrand, detailed enlargement of head of type,  $\times 2\frac{1}{2}$ ; c, *M. longipinnis* (Weymouth), detailed enlargement of head of paratype,  $\times 3$ .



midway between the eye and the lower angle of the preopercle. Body and head, except snout and lower jaw, covered with minute nonimbricate scales imbedded in the skin; scales of the dorsal region following the course of the upper branches of the myomeric impressions. Scales with 31 radiating striae. Origin of the dorsal fin opposite, or a little before tip of appressed pectoral; the fin long and low, joined to the caudal at base by membrane. Ventrals small, closely approximated, situated below the branchial openings. Color uniform pale olivaceous; the caudal fin dusky; other fins plain, translucent.

This species is represented by the type, 84 mm in standard length, U.S.N.M. no. 84301, collected at Chame Point, Panama, by Robert Tweedie, and two paratypes, no. 82680, 68 and 96 mm, respectively, from the same locality, taken March 8-14, 1913, by Mr. Tweedie.

This species is close to *M. affinis* Meek and Hildebrand and *M. longipinnis* (Weymouth) but differs in the position of the vent, fewer body vertebrae, and proportional measurements.

MICRODESMUS MULTIRADIATUS Meek and Hildebrand

FIGURE 12, b; PLATE 2, FIGURE 8

*Microdesmus multiradiatus* MEEK and HILDEBRAND, Publ. Field Mus. Nat. Hist., zool. ser., vol. 15, no. 249, p. 958, pl. 98, fig. 3, 1928 (Panama).

Body very elongate, eel-shaped, the caudal notably longer than rest of body. Head 9.7 to 12.8 in standard length; depth 20.2 to 28.0; predorsal 6.6 to 8.5; preanal 2.4 to 2.7; caudal without fin 1.6 to 1.7; preventral 9.7 to 11.6; base of ventrals to vent 3.2 to 3.6. Snout 4.0 to 6.0 in length of head, measured from tip of lower jaw to upper end of gill openings; interorbital 3.2 to 6.1. Dorsal 73 to 78, anal 57 to 61, pectoral 12, ventral I-3. Eye small, high, superlateral; mouth comparatively large, little oblique, the maxillary to anterior edge of eye. Lower jaw projecting with a small inconspicuous fleshy tip. Lips very large, restricted laterally, the free flange above and below very conspicuous, the two membranes joined together around the posterior end of the gape; the free folds of the lips do not extend around the mouth anteriorly. Snout and lower jaw with pronounced longitudinal swollen muscular ridges, those of the lower jaw extending well back under the mandible. Anterior nostril in a minute porelike opening at the oral end of the outer frontal ridges. Posterior nostril in a small round opening on the frontal ridge before and in front of the eye. Muscles of the jaws well developed, the cheeks somewhat tumid. Teeth comparatively strong, in two irregular series in the jaws, the lower jaw with three or four small canines in the outer series, vomer and palatines toothless. Gill openings restricted laterally, adnate to the scapular region in front of the base of the upper fourth pectoral ray, the aperture extending

obliquely downward and forward to below and in front of the lower pectoral ray, the length of the opening about equal to width of the base of the fin. Body and head, except snout and lower jaw, covered with minute nonimbricate scales imbedded in the skin; at the base of the dorsal fin the arrangement of the rows of scales is strongly differentiated in that they follow the upper branches of the myomeric impressions. Scales with 37 radiating striae. Myomeres conspicuous, 19 to 21 body and 38 to 42 caudal=57 to 63 muscular impressions. Vertebrae, 22 body and 40 caudal=62. Origin of dorsal opposite tip of appressed pectoral. Dorsal and anal fins long and low, both attached to the caudal at base by membrane, the fins similar, but the anal much shorter. Ventrals small, short, closely approximated, their insertion directly below the pectoral base. Pores of the head small and not of very definite arrangement; four rows of pores radiating from the eye across cheek, two rows across interorbital region, and several short lines of pores on temporal region and gill covers. Color brownish, the caudal slightly darker, fins immaculate.

We have 30 specimens of this fish ranging from 77 to 203 mm in standard length, of which the type, U.S.N.M. no. 82682, is 191 mm in standard length. Collected at Chame Point, Panama, by Robert Tweedlie. The paratypes (nos. 82704, 85766) are from the same locality.

This form is distinguished from all other species of the genus by the greatly increased number of rays in the vertical fins and the fewer abdominal vertebrae.

**MICRODESMUS LONGIPINNIS (Weymouth)**

FIGURE 9, *g*; FIGURE 12, *c*; PLATE 2, FIGURE 9

*Leptocerdale longipinnis* WEYMOUTH, Proc. U. S. Nat. Mus., vol. 38, pp. 142-144, figs. 1-2, 1910 (Louisiana).

Body extremely elongate, slender, somewhat compressed and of nearly equal depth throughout. Head moderately long, the lower jaw strongly projecting with a prominent conical fleshy projection at the symphysis. Snout and lower jaw with well-defined longitudinal ridges. Lips thin with rather small flanges or folds confined to the side, the free margin of which does not continue around the front of the mouth. Eye small, high, about 2 in interorbital width. Head 15.3 to 16.8 in standard length; depth 28.3 to 34.4; predorsal 10.1 to 10.4; preanal 2.1; caudal 1.8; preventral 15.5 to 15.9; base of ventrals to vent 2.2 to 2.6; snout 6.4 to 8.1 in length of head, measured to upper end of gill opening; interorbital 7.1 to 7.5. Dorsal 66 to 71, anal 41 to 45, pectoral 12, ventral I-3. Teeth very small, close-set, in two irregular series in the jaws; vomer and palatines toothless.

Gill openings restricted laterally, the upper end in front of upper pectoral ray, extending obliquely downward and forward to below base of lower pectoral ray, the aperture longer than width of the base of the pectoral fin. Origin of dorsal fin above tip of appressed pectoral, the fin of medium height and joined to caudal at base. Anal similar to dorsal but much shorter, also joined to caudal by membrane. Scales very small, covering body and head except snout and lower jaw; the rows of scales at the base of the vertical fins diverging outward and backward following the course of the upper myomeric depressions. Scales with 25 radiating striae. Myomeres evident, 31 body and 37 caudal=68 muscular impressions. Vertebrae, 28 body and 34 caudal=62. Color plain light brownish, fins translucent.

Two specimens, 174 and 207 mm in standard length; taken with a jacklight at night in the outlet of Calcasien Lake, Cameron, La. U.S.N.M. no. 64157 (type) and no. 64158 (paratype).

This species is most closely related to *M. affinis* Meek and Hildebrand, agreeing in the number of body and caudal vertebrae as well as fin rays, but differs notably in the position of the vent and in proportional measurements.



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## TWO NEW SPECIES OF HAWKS FROM THE MIOCENE OF NEBRASKA

By ALEXANDER WETMORE

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FROM collections made by Ted Galusha, the United States National Museum recently has obtained two fragmentary metatarsi that represent, respectively, new species in the families Accipitridae and Falconidae. Both are of more than usual interest, the first because it reveals an additional American species of the subfamily Aegypiinae, whose living representatives are found only in the Old World, and the second because it carries the group of falcons in America back into the Miocene.

In connection with work on the falcon I have had the benefit of examination of the type of *Falco falconellus* Shufeldt, of uncertain status, through the kindness of Dr. Richard S. Lull and Dr. Malcolm R. Thorpe, of the Peabody Museum, Yale University. The drawings herein were made for me by Sidney Prentice.

### Family ACCIPITRIDAE

#### Genus PALAEOBORUS Coues

#### PALAEOBORUS HOWARDAE, new species

*Characters*.—Distal end of tarso-metatarsus (fig. 13) similar to that of *Palaeoborus umbrosus* (Cope)<sup>1</sup> but slightly larger; outer intertrochlear sulcus broader; middle trochlea relatively larger;

<sup>1</sup> *Cathartes umbrosus* Cope, Proc. Acad. Nat. Sci. Philadelphia, vol. 26, Oct. 10, 1874, p. 151. Metatarsus illustrated in Cope, Rep. U. S. Geogr. Surv. West 100th Merid., vol. 4, pt. 2, 1877, pl. 67, figs. 15, 15a, 15c.

tendinal impression on inner posterior angle narrower and more heavily impressed on the shaft in its upper portion.

*Description.*—Type, U.S.N.M. no. 13897, distal end of right tarso-metatarsus, from Miocene of Quarry A in sec. 29, T. 31, R. 47, Dawes County, Nebr., collected in 1934 by Ted Galusha. Outer trochlea narrow, compressed laterally, with a thin plate projecting posteriorly, elliptical in outline when viewed from the side; inner face much excavated, intertrochlear sulcus separating it from middle trochlea distinctly wider than that between internal and middle trochlea; middle trochlea nearly circular in outline when viewed from the side, relatively strong and robust; distinctly elevated from the level of the shaft both posteriorly and anteriorly, with a pronounced groove extending completely around the articular surface; both faces much

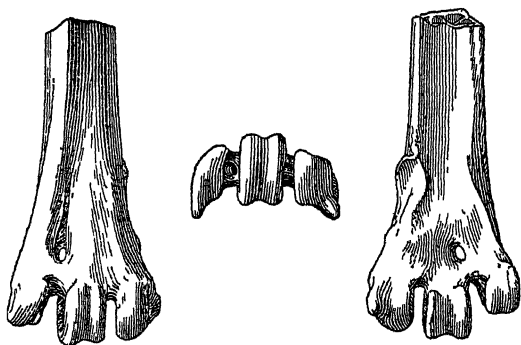


FIGURE 13.—*Palaeoborus howardae*, new species: Distal end of tarso-metatarsus of type (U.S.N.M. no. 13897) About natural size.

excavated; inner trochlea compressed, with a distinct impression in center of outer face, beyond which the bone extends as a narrowed projection triangular in general outline; inner face much excavated; intertrochlear sulcus between it and middle trochlea decidedly narrowed; lower end of shaft flattened and expanded, forming a broad base from which project the trochlea; inferior foramen of good size, located relatively low on the shaft, with a slight depression around it behind, and a distinct groove leading into it from above on the anterior face; body of shaft strong and robust, with outer face plain, the boundaries being sharp-ridged both in front and in back; a strongly impressed tendinal groove on inner angle; posterior face of shaft with a broad, shallow groove above; impression for articulation of hallux strongly marked; anterior face of shaft a somewhat irregular plane sloping toward the inner margin. Bone well fossilized, dull gray in color, whiter on the trochlea.

*Measurements.*—Smallest transverse breadth of shaft, 9.7 mm; transverse breadth across trochlea, 20.4 mm.

*Remarks.*—This species seems to have been one with strong and robust foot, indicating a distinctly predatory type of life. The short, heavy form of the inner trochlea, with the relatively slightly projecting wing, and the relatively large size of the middle trochlea com-

pared with the others, place it in the subfamily Aegypiinae, adding another species to this group in the New World. It has the strong, robust form of *Neogyps errans*, but in detail of structure it is more similar to the more slightly built *Neophrontops americanus*.

From *Neophrontops americanus*, in addition to its much larger size, *P. howardae* differs in having the larger and more robust middle trochlea projecting abruptly on the anterior face, instead of merging gradually into the shaft; the external intertrochlear sulcus much wider; the axis of the ala interna of second trochlea making a right angle with axis of shaft, so that its point is elevated above lower margin of trochlea instead of nearly on the same level; the inferior foramen less elevated; and a strongly impressed tendinal groove on posterior face of outer margin of shaft.

*Neophrontops dakotensis* Compton<sup>2</sup>, described from the lower Pliocene of South Dakota, is decidedly smaller.

*Palaeoborus howardae* agrees so closely with *P. umbrosus*, which Dr. Hildegarde Howard<sup>3</sup> has included in the subfamily Aegypiinae, that after some consideration, including a careful study of Cope's figures, it is described in the genus *Palaeoborus*. I have not been successful in locating Cope's type material, but should this subsequently be found comparison of the actual specimens may indicate that the species here named should be placed in a separate genus.

I have pleasure in naming this species for Dr. Hildegarde Howard in recognition of her excellent work on the eagles and eaglelike vultures of the Pleistocene deposits of California.

## Family FALCONIDAE

### Genus FALCO Linnaeus

#### FALCO RAMENTA, new species

*Characters*.—Distal end of tarso-metatarsus (fig. 14) generally similar to modern *Falco columbarius* Linnaeus<sup>4</sup> but decidedly smaller; inferior foramen viewed from posterior surface more elevated on shaft.

*Description*.—Type, U.S.N.M. no. 13898, distal portion of right metatarsus, from Miocene of *Merychippus* quarry, in southwest corner of NW¼, sec. 14, T. 31, R. 47, Dawes County, Nebr., collected in 1934 by Ted Galusha. Shaft slender but strong; anterior face with a faintly impressed, very shallow groove toward inner margin that disappears completely well above trochlea, the surface becoming smoothly curved at that point; opening for anterior foramen very

<sup>2</sup> Amer. Journ. Sci., vol. 30, Oct. 1935, p. 344, fig. 1.

<sup>3</sup> Carnegie Inst. Washington Publ. 429, Oct. 1932, p. 70 et seq.

<sup>4</sup> Systema naturae, ed. 10, vol. 1, 1758, p. 90 (South Carolina).

small, located in a slightly indicated, narrow groove; posterior surface of shaft with raised margins, making a broad, shallow trough; facet for articulation of first toe well marked, rather elevated on side of shaft; supporting base for trochleae broad and flattened, with the curve of the trochlea open; inner trochlea with distal margin even with middle trochlea, rounded, with internal face somewhat excavated, anterior surface smoothly rounded, with a flattened plate, most of which has been broken away, projecting from its free margin; internal intertrochlear sulcus open, but relatively narrow; middle trochlea small, projecting somewhat anteriorly beyond those on either side, nearly round in lateral outline, its free margin deeply grooved, on the posterior face descending abruptly into shaft; the entire trochlea distinctly smaller than those on either side; outer trochlea viewed from outer face a flat, crudely elliptical plate, its

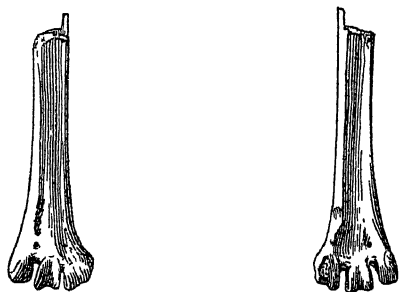


FIGURE 14.—*Falco ramenta*, new species: Distal end of tarso-metatarsus of type (U.S.N.M. no. 13898). Twice natural size.

margin not extended quite so far as the end of the middle trochlea; outer trochlea posteriorly developed in an angular plate that extends much farther back than the other two, the plate in question much narrowed, being less than half the width of the main part of the trochlea; external intertrochlear sulcus narrow and shallow; inferior foramen on posterior surface a tiny rounded opening, located at a point above the base of the outer trochlea. Specimen well fossilized; color dull ivory, mottled with gray.

*Measurements.*—Greatest transverse breadth across trochlea, 5.3 mm; smallest transverse breadth of shaft, 2.3 mm.

*Remarks.*—The species here described, from the evidence to be found in the lower end of the metatarsus, was about the size of the male of the small race of sparrow hawk resident in Florida, *Falco sparverius paulus* (Howe and King). The elevation of the inferior foramen on the shaft is similar to what is found in the sparrow hawks, the pigeon hawks having this opening nearer the base of the outer trochlea. The metatarsus in the fossil, however, is distinctly heavier, and the facet for the articulation of the first digit is extended farther up the shaft, characters that distinguish *F. columbarius* and *F. sparverius* as species. It seems, therefore, that *F. ramenta* was related more nearly to the pigeon hawks, being distinguished from any of the living forms in this group by decidedly smaller size. This difference is more evident in the smaller, more

delicate form of the trochlea than from measurements and is readily apparent on comparison of specimens.

Ted Galusha, from whom the type of *Falco ramenta* was obtained, informs me that his "*Merychippus* quarry", where the specimen was found, is characterized by remains of *Merychippus primus*, *Hypohippus*, *Merycodus*, and *Mylogaulus*, among other mammals. He considers it probably equivalent to the Sheep Creek beds. The exact level in the Miocene of this deposit remains to be definitely established, but it seems probable that it is located in the middle or lower upper Miocene.

Other pigmy species related to forms still living have been found in the same general period of geologic time. These include *Ortalis tantala*, a chachalaca less than half the size of the modern species in this group; *Paractiornis perpusillus*, an oystercatcher with the stature of a sanderling; and *Conuropsis fratercula*, which resembles the Carolina parakeet but is only three-fourths as large. It would appear that the latter half of Tertiary time was highly favorable to diversity of form among birds, so that there were developed many size types that with the incidence of more rigorous conditions in Pleistocene and Recent times became extinct.

#### STATUS OF *FALCO FALCONELLUS* SHUFELDT

In considering the affinities of *Falco ramenta*, I have had the privilege of examining the type material of *F. falconellus* Shufeldt through the kindness of Dr. Richard S. Lull and Dr. Malcolm R. Thorpe. This species, described as *Falco falconella*<sup>5</sup> was named according to Shufeldt from "five (5) fossil bones or fragments of bones which, in life, evidently belonged to either a small Owl or a small Falcon or Hawk." The specimens come from the Bridger Eocene of Wyoming. The type material, all of which is fragmentary, includes the following:

(1) A bit of an articular surface or process that is not avian; without comparing it definitely I consider it mammalian.

(2) A phalanx from the foot of some small bird.

(3) A much compressed unguis from the foot of a larger bird than no. 2.

(4) Head of the left coracoid of a small bird.

(5) Distal end of the left humerus of a small bird.

After prolonged and careful examination and many comparisons with modern birds, I am forced to the conclusion that *F. falconellus* cannot be identified. The material includes representation from at least three orders of birds. The fragmentary humerus is the only

<sup>5</sup> Trans. Connecticut Acad. Arts and Sci., vol. 19, Feb. 1915, p. 40, pl. 15, figs. 139-143.



bone of the five that might offer characters to indicate relationship, but this is so crushed and broken that I have not been able to establish the family, or even the order, to which it belongs. The only pertinent character evident is that of reduction in the radial condyle, which has the articulating surface cut away. There is little else that may be said about it, except to indicate that it is not from a species of the order Falconiformes. With considerable reluctance I am forced to the conclusion that it is necessary to relegate *Falco falconellus* Shufeldt to the limbo of those species that may not be given a place in our systematic classification.



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# A NEW NORTH AMERICAN MASON-WASP FROM VIRGINIA, WITH NOTES ON SOME ALLIED FORMS

By JOSEPH BEQUAERT

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A MASON-WASP, recently discovered in Virginia, belongs to an apparently undescribed form of *Odynerus tempiferus* Viereck, a species related to *O. pratensis* H. de Saussure. Both these species differ from the other North American *Odynerus* in having the entire first and the greater part of the second tergite (except for a preapical zone of coarse punctures) practically impunctate. The two species may be separated as follows:

Lateral angles of propodeum prominent, broadly triangular, with sharp apex. Clypeus (♀ ♂) scarcely or not wider than high, the apical margin slightly curved inward and with prominent, sharp lateral teeth. Humeral margin of pronotum with a low carina, which is narrowly interrupted in the middle; dorsal face of pronotum evenly rounded off into the lateral, vertical areas. Thorax short and thickset.....tempiferus

Lateral angles of propodeum broadly and evenly rounded off. Clypeus (♀ ♂) nearly one and one-third times as wide as high, the apical margin straight, its lateral angles not toothlike. Humeral margin of pronotum with a high carina, continuous across the middle; dorsal face of pronotum separated from the lateral, vertical areas by a ridge, particularly prominent and often somewhat carinate at the humeral angles. Thorax elongate.....pratensis

## Genus ODYNERUS Latreille

## ODYNERUS TEMPIFERUS Viereck

*Odynerus (Stenodynerus) tempiferus* VIERECK, Trans. Amer. Ent. Soc., vol. 33, p. 392, pl. 12, fig., 1908 (♂; Thomas Ranch, Oak Creek Canyon, 20 miles southwest of Flagstaff, Coconino County, Ariz.).

*Odynerus trichiosomus* CAMERON, Pomona Journ. Ent., vol. 1, p. 127, 1909 (♂; Gallinas Canyon, N. Mex.).

Viereck's description mentions only the color markings, although he adds that except for the length of the thorax his species agrees in size and structure with de Saussure's description of *O. iturbidi*, from Mexico.<sup>1</sup> *O. tempiferus* may, however, be recognized from Viereck's figure, which represents a *male*, not a female as marked. *O. trichiosomus* seems to be the same species, as suggested by the following excerpts from Cameron's description: "Clypeus pyriform, slightly but distinctly longer than wide, the apex with a shallow rounded incision \* \* \*. First abdominal segment cupshaped, smooth, the second as wide as long, the basal two-thirds smooth, the apical deeply irregularly, but not very closely punctured." The length (11 mm) was probably measured from the frons to the apex of the second tergite.

Although in coloration the typical form of *O. tempiferus*, as here recognized, is strikingly different from the variety *macio*, both agree structurally in every detail. In addition to the characters mentioned in the key, *O. tempiferus* differs from *O. pratensis* in several other structural peculiarities, which may be found in the lengthy account of *macio* given below. For instance, the basal two-thirds of the second tergite are not so completely devoid of punctures in *O. tempiferus*, that area appearing much smoother in *O. pratensis*. The antennal hook of the male is shaped quite differently in the two species. *O. pratensis* does not appear to reach the size of the largest *O. tempiferus*.

*Female (undescribed).*—Black. Clypeus, transverse flattened hexagonal spot above interantennal ridge (sometimes including the ridge), broad margins of inner orbits from clypeus to bottom of ocular sinuses, spot at base of mandible, major part of cheeks, a streak on under side of scape, anterior half of dorsal face of pronotum, two spots on scutellum, usually most of transverse ridge of postscutellum (sometimes lacking), spots on dorsal areas of propodeum, tegulae (except median ferruginous spot), large spot on upper plate of mesepisternum (beneath base of fore wing), most of horizontal dorsal area of first tergite (except a median spot, produced posteriorly into a line), broad apical margins on succeeding tergites and sternites, lateral spots on anterior half of second tergite (sometimes very small, or connected with the apical margin), spots

<sup>1</sup> *O. iturbidi* is unknown to me. H. de Saussure's description does not mention clearly that the first and basal two-thirds of the second tergite are impunctate.

on coxae, apices of all femora and outer sides of all tibiae, bright yellow or more or less orange-yellow. Scape, base of flagellum, mandibles, most of legs, and lateral spots on second tergite ferruginous. The edges of all yellow markings are usually more or less ferruginous, particularly on the cheeks, pronotum, second and sixth tergites, and most sternites. In one specimen the mesonotum has two ferruginous stripes. Wings subhyaline, tinged with amber-yellow, more russet toward costa, and with slight purple reflections. In one specimen the clypeus has a median blackish spot and is partly ferruginous.

*Male*.—Much like the female and equally variable in the relative extent of yellow and ferruginous markings. In one specimen the second tergite is mostly yellow, shading into orange toward the middle, while several other pale markings of the body are orange rather than yellow. The mandibles, tibiae, and tarsi may be more extensively yellow than in the female.

Length (h.+th.+t.1 and 2): ♀, 12.5 to 14 mm; ♂, 11 to 12 mm; of fore wing: ♀, 14 to 15 mm; ♂, 11.5 to 12.5 mm.

*Specimens examined*.—Colorado: Clear Creek, 6,000 to 7,000 feet, Jefferson County, female allotype, June 29, 1922 (George P. Engelhardt, Mus. Comp. Zool.); Boulder County, female, bred from a mudnest (C. H. Hicks); Golden, 6,000 to 7,000 feet, Jefferson County, female (H. H. Newcomb); Chimney Gulch near Golden, Jefferson County, male; Custer County, female (T. D. A. Cockerell).

New Mexico: Jemez Mountains, Sandoval County, male (Woodgate); Las Vegas, female (Deacy).

Wyoming: Sheridan, Sheridan County, female (Cornell University).

Utah: Eureka, Juab County, female (T. Spaulding); Beaver Valley, two females; Beaver Creek Hills, two males; Wildcat Valley, male; South Creek, male; all Beaver County (George P. Engelhardt); Buckskin Valley, Iron County, male and female (George P. Engelhardt).

Oregon: Horse Lake, High Cascade Mountains, Lane County, male (J. C. Bridwell).

Mexico: Meadow Valley, State of Chihuahua, female (C. H. T. Townsend).

According to C. H. Hicks' observations, the typical form of *O. tempiferus* has habits similar to those of the variety *macio*.

ODYNERUS TEMPIFERUS MACIO, new variety

*Characters*.—Similar to *O. tempiferus*, differing principally in having bluish-black wings, darker bases of legs, and considerable reduction of the light color markings on the head, pronotum, and abdomen, which are ivory-white instead of bright yellow or somewhat orange-yellow.

Since the typical form of *O. tempiferus* was incompletely described, I feel justified in describing fully the variety *macio*.

*Female*.—Head (fig. 15, A) in front view broadly elliptical, slightly wider than high; seen from above, transverse, two and one-half times as wide as long, as wide as thorax; occipital margin slightly curved inward. Vertex and cheeks margined throughout by a sharp uniform carina. Cheek wide, in profile as wide as upper half of eye, gradually narrowed from middle to mandibular condyle, where it forms a narrow groove. Inner orbits at vertex one and one-fifth times as far apart as at clypeus. Upper half of frons little swollen, with distinct but shallow median saddlelike depression between anterior ocellus and interantennal ridge. Ocelli in a flattened triangle, poste-

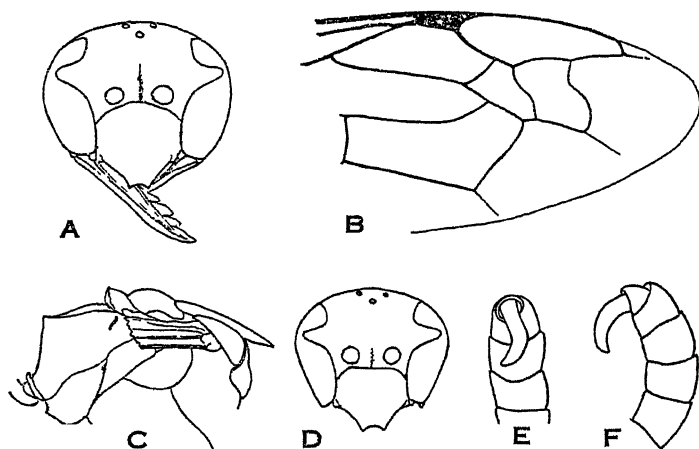


FIGURE 15.—*ODYNERUS TEMPIFERUS MACIO*, new variety

A—C, female: A, Head in front view; B, apical half of fore wing; C, hind portion of thorax in side view.

D—F, male: D, Head in front view; E, tip of antenna from below; F, tip of antenna in side view.

rior pair twice as far apart as from the anterior, slightly less than from eyes, about as far from eyes as from occipital margin. Inter-ocular area flat with median longitudinal linear groove. Vertex medially with two minute hairy foveae, close together and slightly nearer occipital margin than posterior ocelli. Antennae twice as far apart as from eyes; ridge between them low. Clypeus very broadly pear-shaped, scarcely wider than high, disk slightly flattened, upper part moderately convex, with weak preapical concavity; lower subocular portion about as long as interocular part; truncate apex about one-fifth greatest width of clypeus, very slightly incurved with short but sharp, toothlike lateral edges. Antennae rather long and slender, flagellum scarcely swollen apically; scape slender, distinctly curved,

much less than half length of flagellum; third segment about one and one-half times as long as fourth; fourth to sixth longer than wide; seventh and eleventh almost square; eighth to tenth slightly wider than long; twelfth about as long as basal width. Mandible straight, nearly as long as eye; apex blunt, hardly curved; inner margin with four narrow notches producing broad, bluntly rounded teeth. Maxillary palpi 6-segmented; four basal segments gradually shorter, three terminal segments combined much longer than third; labial palpi 4-segmented. Thorax (fig. 15, C) short and very stubby, sides almost parallel, narrowed slightly anteriorly; seen from above little longer than greatest width, in profile almost as high as long. Humeral margin of pronotum slightly curved inward, margined dorsally by a very fine carina, interrupted medially, on sides more sharply carinate to anterior coxae; humeri very broadly rounded; pronotum without carina between dorsal horizontal and lateral vertical areas. Mesonotum about as wide as long, nearly pentagonal in outline, with broadly rounded anterior margin, very slightly convex, with mere traces of notauli and parapsidal furrows posteriorly, anterior fourth with fine, impressed median line. Tegula semielliptical, nearly twice as long as wide, with somewhat carinate margins; posttegula forming a broad lobe, somewhat curved upward, with blunt apex. Scutellum rectangular, about three times as wide as long, very slightly raised, disk somewhat flattened, with a fine median longitudinal impressed line, deep mesonotal suture foveolate, with longitudinal riblets; postscutellar suture moderately impressed, not foveolate. Postscutellum convex, with a short anterior horizontal area and much longer, posterior, vertical portion (part of the concavity of propodeum), separated by a sharply crenulate, transverse crest (of 8 to 10 irregular teeth), narrowly interrupted medially by a groove. Median mesepisternal groove very deep, complete, transversely ribbed; prepectal suture present in lower part only as a fine carina, running obliquely to near base of mid coxa. Propodeum very short, squarely and vertically truncate behind, swollen laterally; dorsal areas very broadly separated medially by vertical face of postscutellum; concavity wide and deep, divided by a low, broad, smooth longitudinal ridge, which expands suddenly into a broad triangle along hind margin of postscutellum; no superior ridges; inferior and lateral ridges bluntly rounded, without carinae or teeth; lateral angles prominent, broadly triangular, with sharp apex; lateral areas slightly concave. Abdomen short and very stubby. First tergite short, transverse, with faint trace of median impressed line posteriorly, as broad as thorax and scarcely narrower than second; seen from above, broadly semielliptical in outline, width of hind margin little over median length; transition between vertical and horizontal areas evenly but strongly convex and rounded off; hind margin

translucent, not thickened or raised. Second tergite about twice as wide as long, moderately and evenly convex; hind margin slightly thickened but not raised or translucent; preapical, coarsely punctate area depressed, more strongly laterally. Apical margins of succeeding tergites normal, of third very slightly thickened. Second sternite evenly and rather markedly convex toward base, with basal median furrow; deep basal transverse groove with irregular longitudinal riblets. Apical margins of sternites simple. Legs normal. Wings with usual type of venation (fig. 15, B); radial cell rather elongate, broadest before middle (at second intercubitus), apex narrowly truncate, with short appendicular vein; second cubital more than four times as long on cubitus as on radius; third cubital much shorter than second, much higher than long, slightly wider on radius than on cubitus; third intercubitus very wavy.

Vertex and cheeks fairly uniformly covered with scattered medium-sized punctures, those on frons much coarser and closer. Mandibles almost impunctate. Disk of clypeus with uniformly scattered small punctures and traces of irregular longitudinal folds; sides and base more finely and densely punctate. Pronotum, mesonotum, and scutellum rather densely covered with a mixture of medium-sized and small punctures; those of mesopleura very much coarser, producing a reticulate or somewhat striolate appearance; upper half of metapleura transversely striolate, lower half almost smooth; postscutellum coarsely punctate, except the smooth posterior portion. Propodeum: Dorsal areas coarsely punctate, subreticulate; lateral areas strongly obliquely striate; concavity obliquely striate laterad of median ridge. Tegulae with few minute punctures anteriorly and posteriorly. Abdomen: First tergite (under a hand lens) impunctate; basal three-fourths of second tergite with widely scattered minute punctures, coarsely and densely punctured, depressed preapical area extending forward laterally; remaining tergites coarsely punctate but gradually decreasing to sixth, which bears only a few small and many fine punctures; punctures of sternites small and much scattered, but larger and closer before apex of second. Pubescence short and rather inconspicuous, mostly brownish black or black, more grayish on frons and sides of propodeum.

Black. An elongate spot on base of mandible, extreme upper sides of clypeus, narrow inner orbits from clypeus to near base of ocular sinuses, narrow streaks in upper half of cheeks along outer orbits, anterior half of dorsal area of pronotum, tegulae, except for a brownish median spot, small spot on upper plate of mesepisternum, two spots on scutellum, large spots covering most of dorsal areas of propodeum, most of dorsal area of first tergite (except a large median pentagonal black spot, produced posteriorly into a

linear point), narrow apical margins of second and third tergites (sometimes faint or absent on third), spots near apices of fore and mid femora, and outer sides of all tibiae, ivory-white. One female has also an ivory-white spot on frons above interantennal carina, while another has two obscure preapical spots on clypeus. Knees, inner side of tibiae, most of tarsi, claws, and tibial spurs, russet. Wings uniformly strongly infusate, bluish black with purplish reflections; veins and stigma black.

*Male*.—Similar to female except as follows: Head (fig. 15, D), seen in front, subcircular, only slightly wider than high. Frons scarcely depressed above interantennal ridge. Vertex without foveae. Clypeus relatively shorter and wider; its truncate apex nearly one-third of the greatest width of clypeus, distinctly though shallowly curved inward, with blunt lateral edges. Antennae (fig. 15, E-F) somewhat more swollen apically; fourth to eighth segments longer than wide; ninth to eleventh about as long as wide and somewhat swollen; twelfth very long; thirteenth long, slender, strongly curved, with blunt, rounded tip; twelfth and thirteenth folded under, the twisted apex of thirteenth reaching to near base of tenth. Mandible much shorter than eye.

Sculpture much as in the female, but frons less coarsely punctate; clypeus smooth with a few scattered, small punctures.

Coloration as in the female, but clypeus and labrum entirely, most of outside of mandibles, under side of scape, triangular interantennal spot and ventral spots on mid coxae ivory-white. Spots of scutellum and dorsal areas of propodeum small or lacking.

Length (h.+th.+t.1 and 2): ♀, 12 to 13 mm; ♂, 11 to 12 mm; of fore wing: ♀, 13.5 to 14 mm; ♂, 10 to 11 mm.

*Specimens examined*.—Virginia: Mouth of Tobacco Creek, about 25 miles from Fredericksburg (between Essex County and Carolina County), seven females (holotype and paratypes) and five males (allotype and paratypes) bred from a mudnest collected by David I. Bushnell, Jr. The nesting habits are described elsewhere.<sup>2</sup> Holotype (U.S.N.M. no. 51697), allotype, and some of the paratypes at the United States National Museum; other paratypes at Museum of Comparative Zoology, Cambridge, Mass., where there is also a female paratype, from an old collection, without locality.

In coloration, the variety *macio* resembles somewhat *Odynerus bidens* de Saussure, *Ancistrocerus quadrisectus* (Say), and *Monobia quadridens* (Linnaeus), which occur in the same territory. There are, however, differences among the four species in the arrangement of the ivory-white markings, and structurally they are not in the least related. The variety *macio* differs from all the others in the impunctate first and basal two-thirds of second tergite. From the

<sup>2</sup> Proc. U. S. Nat. Mus., vol 84, p. 89 ff., 1936.



*Monobia* it is separated also by having 4-segmented labial and 6-segmented maxillary palpi. It lacks the transverse carina on the first tergite of the *Ancistrocerus*. *O. bidens* has a differently shaped clypeus, the cheeks considerably widened behind the eyes, the post-scutellum without a crenulate transverse ridge, and the concavity of the propodeum separated from the dorsal areas by a more or less distinct carina (forming an upper tooth divided by a notch from the sides of the postscutellum).

ODYNERUS PRATENSIS H. de Saussure

*Odynerus pratensis* H. DE SAUSSURE, Rev. Mag. Zool., ser. 2, vol. 22, p. 61, 1870 (♀ ♂; "America borealis"); Smithsonian Misc. Coll., vol. 14, no. 254, p. 292, 1875 (♀ from Cape St. Lucas, Lower California; ♂ from New Mexico).

*Odynerus clusinus* CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 234, 1872 (♀ ♂; Texas; types collected by Belfrage, therefore probably from Bosque County).

Cresson's *clusinus* and de Saussure's *pratensis* were based upon the same species, even though de Saussure's description does not mention that the first and most of the second tergites are smooth and impunctate.

The typical form of *O. pratensis* is mostly ferruginous, with a few black blotches or spots, particularly on the vertex and mesonotum, and with many yellow markings, most of the tergites and sternites having broad apical yellow margins, always widened anteriorly on the first and sometimes also on the second tergite. Wings subhyaline, tinged with amber-yellow and very slightly violaceous. Length (h.+th.+t.1 and 2): ♀, 11.5 to 12.5 mm; ♂, 8.5 to 10.5 mm; of fore wing: ♀, 10.5 to 11.5 mm; ♂, 8.5 to 11.5.

*Specimens examined*.—Texas: New Braunfels, Comal County; Ozona, Crockett County; Devils River near Comstock, Val Verde County; Fort Davis, Jeff Davis County; Valentine, Presidio County; Fedor, Lee County.

New Mexico: Rio Grande Canyon, south of Taos, Taos County.

Arizona: Flagstaff, Coconino County; Post Creek Canyon near Fort Grant (Pinaleno Mountains), Graham County; Congress Junction, Yavapai County.

Many females and males.

ODYNERUS PRATENSIS BRUMALIS, new variety

*Male*.—Mainly black, extensively marked with yellow and with a few ferruginous blotches. Clypeus, frons to upper margin of ocular sinuses (except two black oblique spots above antennal sockets), most of cheeks and mandibles, under side of scape, anterior portion of dorsal face of pronotum wholly or only medially, ridge of postscutel-

lum broadly, tegulae anteriorly and posteriorly, spot in upper plate of mesepisternum, broad apical margins of tergites 1 to 6, most of sternites 1 to 6, under sides of coxae, tips of femora, and outer side of tibiae, bright yellow; margins of first and second tergites considerably widened laterally, that of second connected with rounded lateral spots. The ferruginous color is never extensive; it may cover most of the scape, base and hook of flagellum, most of dorsal face of pronotum, two spots on scutellum, much of sides of propodeum, most of legs (except where yellow), sides of first and second tergites bordering yellow markings, and seventh tergite and sternite; elsewhere the yellow is often edged with ferruginous. Wings subhyaline, with a slightly yellowish tinge, veins brownish, more russet anteriorly, radial cell slightly infusate and somewhat violaceous.

Length (h.+th.+t.1 and 2): 9.5 to 11 mm; of fore wing, 9.5 to 11.5 mm.

*Specimens examined*.—Washington: Wawawai, Whitman County, three males (holotype and paratypes) (W. M. Mann); Almota, Whitman County, one male (paratype) (A. L. Melander). All at the Museum of Comparative Zoology.





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THE NEST OF *ODYNERUS TEMPIFERUS* VAR. *MACIO*  
BEQUAERT, WITH NOTES ON THE HABITS OF THE  
WASPS<sup>1</sup>

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and

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ALTHOUGH much has been written on the habits of various solitary wasps, nearly all the available information has to do with the construction and storing of the cells and the capture of the prey. Little has been recorded concerning the habits of the insects immediately after reaching the adult stage.

The rearing of a series of individuals of both sexes of *Odynerus tempiferus* var. *macio* Bequaert<sup>2</sup> from a nest brought to us by David I. Bushnell, Jr., gave us an opportunity for making notes upon the habits of this wasp based upon individuals the entire history of which, as adults at least, was known. As the nest was too fragile to send to Dr. Bequaert for study after the emergence of the wasps, a description of it is included herein.

*Locality.*—At the mouth of Tobacco Creek, between Essex and Caroline Counties, Va., 25 miles from Fredericksburg. The nest was collected by David I. Bushnell, Jr., on October 15, 1935.

*Nest.*—The nest was constructed about a fork in a slender alder (*Alnus rugosa*) twig that is 4 mm in diameter just beneath the nest.

<sup>1</sup> The studies recorded herein of the reactions of these wasps to light were made in co-operation with Dr. E. D. McAlister, Division of Radiation and Organisms, Smithsonian Institution.

<sup>2</sup> Proc. U. S. Nat. Mus., vol. 84, pp. 79–88, 1936.

The weight of the nest (3.5 ounces with the surface dry) bowed the twig so as to bring it within 4 or 5 feet of the ground.

The nest consists of a large, somewhat irregular mass, with large, low, broadly rounded humps. It is constructed chiefly of coarsely sandy clay. On the surface are embedded a few large quartz grains up to 2.5 mm in diameter. In one place there is a rounded patch or overlay about 10 mm in diameter of finer and lighter-colored clay. The length in the direction of the supporting twig is 60 mm; the greatest diameter, at right angles to the length, is 60 mm; and the least diameter is 55 mm.

There are 21 included cells. These are kidney-shaped, with the concave side toward the twig, 12 to 15 mm long and 7 to 9 mm high in the middle. They are somewhat broader than high. In transverse section the floor, always toward the twig, is seen to be straight, the sides and top strongly and evenly arched. The partitions between the cells are 3 to 5 mm thick in the thinnest place.

The first cell is placed in the fork with the long axis at right angles to the plane of the diverging branchlets and the sides almost touching them. The concave side, or floor, is toward the fork and 10 mm distant from it. The second and third cells are on either side of the fork, on the outer side of the diverging branchlets. The other cells are arranged concentrically about the fork as a center, all evenly spaced from one another, the long axes running in any direction.

The nest was brought to us in the middle of October and was kept indoors during the winter. It probably was not exposed to a temperature of less than 65° F. during that time. It was placed in a cloth-covered glass jar with about an inch of saturated newspaper in the bottom, and the surface was thoroughly soaked under the tap once or twice a week.

This soaking of the surface had the effect of washing out the colloidal material, so that by the time the wasps were ready to emerge the surface had become very friable, fine sand falling from it at the slightest touch or jar. The effect of this would be greatly to facilitate the emergence of the insects.

A thorough search was made for the remains of the insects with which the cells had been stored, but no trace of any was found.

The cocoon, formed of a rather sparse layer of silk supporting a continuous sheet of gummy substance, is thin and delicate.

*Emergences.*—Two males, March 4; two males, March 5; the emergence of the males occurred before 9 a. m., except in one case in which the emergence was not completed until shortly after that time.

One female, March 15; one female, March 17; on March 18 the nest, which had become very dry, was thoroughly wetted about 10 a. m., and within 15 minutes a female emerged; one female, March 19; one

female, March 23, at 9:15 a. m. and another on the same date at 10 a. m.

Total, 4 males and 6 females.

The male that emerged shortly after 9 a. m. was assisted by the wetting of the nest. Not long after emergence he retreated within the cell and remained looking out. The female that emerged after the wetting of the nest retired into a cell about 1 p. m. and spent the rest of the day there.

The emergence holes of the males are 4 mm in diameter and those of the females are 6 mm in diameter.

*Parasite.*—One of the cells that was opened before the emergences began contained a dead larva and a dead adult tachinid, with its pupal skin. The tachinid was very moldy. It was determined by David G. Hall as one of the Miltogrammini.

*Contents of other cells.*—Dead larvae, 4; dead male, 1; dead female, 1; crippled female, 1; male ready for emergence (March 3), 1; living larva (February), 1; empty, except for mold, 1.

*Habits.*—Immediately after emerging most of the wasps were nervous and suspicious, and if a hand was brought within 4 or 5 inches of them they faced it and took a defensive attitude. But none of them were in the least aggressive, and the female that emerged on March 23 paid no attention to a finger within half an inch. The suspicious attitude on the part of the others was soon lost, and they showed no concern when objects in their jar were rearranged with the hand or when a finger came within an inch or less of them. However, they were not disturbed on sunny days when they were flying about.

In sunlight they are very active, but if it becomes cloudy they cease flying at once, crawl about for a while, and come to rest, no matter how warm it may be.

The flight of the females is direct and clumsy. The flight of the males is more agile than of the females, with frequent quick turns and much hovering, accompanied by an oscillation from side to side covering a distance of about an inch and a half. The females occasionally hovered, remaining stationary in the air with the body at an angle of about 45°.

When resting the wings are held parallel close down upon the back, and usually the fore legs are drawn up from the supporting surface, sometimes with the tips of the tarsi crossed. The antennae diverge at an angle of 90° and are slightly ascending. In the females the antennae are straight, but in the males the distal fourth is recurved so that the tip points backward at an angle of about 45° with the body axis. When completely at rest the head is tilted forward and the antennae are depressed so that they almost or quite touch the supporting surface.

Two tall corks placed in the jar were greatly appreciated, and at least one or two of the wasps could always be seen resting upon them.

The first female to emerge had a very characteristic defensive attitude. She stood with the body making an angle of about  $45^{\circ}$  with the direction of the annoying finger, head to the left, the body tilted to the right side and the abdomen turned slightly to the left. The legs of the first pair were drawn up close against the body, and the tarsi twitched constantly, about once a second, sometimes simultaneously and sometimes alternately, or changing from one to the other. This female was irritable and bad tempered. If any of the others approached her when she was resting she would make a lunge at them, without moving her feet, and menace them with her jaws. For resting she always chose a place near the bottom of the jar on the dark side of one of the corks. She was never able to climb up the glass side of the jar. Her never-failing bad temper, combined with her small size and other features, made her always readily identifiable.

The second female to emerge, which was considerably larger than the first—in fact the largest female of all—was of a very placid disposition. At first she was mildly startled at the appearance of a finger close to her, but only to the extent of facing it and watching it closely. She never assumed a defensive attitude, and never, except when resting, drew up the fore legs. She was able to climb up the glass without difficulty and at once chose the cloth covering of the jar as a resting place (as one of the four males had done), on the first day spending a large part of her time trying to bite through it. Two of the females that emerged later often joined her on the cloth.

All the females but the first were good tempered and, though not particularly sociable, never menaced one another.

At the time the first female emerged the only surviving male seemed entirely inert, spending all his time resting on the dark side of a large cork. But with the introduction of two females into the jar he immediately became very lively.

Having been in the jar for many days he knew it well and flew about without hitting the glass sides or falling into the water dish. The females frequently bumped into the glass and often, rebounding from the glass, fell into the water back downward. One of them always extricated herself without difficulty, but on the first day of their imprisonment the others had to be lifted from the water several times. But in less than two days they too learned the limitations of the jar and how to avoid the hazards of the water dish.

The wasps were fed on honey and water, which they ate readily. They would not eat sugar and water. Only one displayed any interest in cherry flowers.

On March 26 a female was placed in a large jar with a heap of mud at one side of the bottom on which was a small pool of standing water, a sprig of flowering cherry, and a forked privet twig. The day was cloudy, and after moving about the jar in a desultory way for about an hour the wasp came to rest behind the bottle of water holding the twigs. The next day was rainy, and the wasp spent the day at the top of the privet twig resting with the tip of the abdomen touching the twig and the body making an acute angle with it, and the forelegs drawn up close to the body.

On the day following the wasp came to the mud at 9 a. m., rested on it for about half an hour, then crawled up the privet twig to the cloth. When sunlight entered the jar the wasp became very active, but spent most of its time on the sunny side of the jar, showing no interest in the mud. It died the next day.

The four remaining females were transferred to the large jar on March 30. None of them showed any interest in the mud.

The first female to emerge died on March 31; she retained her bad disposition to the end, from time to time hovering near and pouncing upon the others.

The last surviving male died on March 26.

The three remaining females were transferred to petri dishes on March 31 for the purpose of subjecting them to experiments with light. All three were found dead on April 3.

After being placed in a petri dish 150 mm in diameter and 20 mm high with white blotting paper covering the bottom, each of three females at the first opportunity (two days later) made a complete examination of the container, running rapidly and irregularly about and investigating every portion of the bottom, top, and sides.

In one petri dish there was on the blotting paper a small blackish spot with a light border about 2 mm in diameter situated 50 mm from the edge. This was promptly discovered by the wasp, which suddenly stopped and whipped down the antennae so that the tips almost or quite touched it, remaining motionless for a second or two. It then started off again but soon returned to the spot, remaining for a short time motionless as before. Every few seconds, after running irregularly about over the blotting paper, it would rush directly to the spot, depress its antennae, and remain motionless. The intervals between the examinations of the spot gradually became longer, but not until it had approached the spot from every direction did it cease making occasional dashes to it.

After the wasp had thoroughly and completely studied the location and nature of the spot, it developed an interest in a small area at the edge of the dish where the blotting paper was turned upward and frayed. Previously it had paused here a few times in passing; but now it turned its entire attention to this region, occasionally leav-



ing for an irregular circuit of the petri dish, but soon returning. It turned its head down so that the front of the head was parallel with the plane of the paper and tore at the fibers with the serrate anterior edge of the mandibles, frequently turning on its side to work to better advantage.

It paid no attention whatever to small spots caused by shadows.

*Reactions to light.*—A very brief study of the response of the wasp to illumination by light of different wave length was made on the first and second of April. This study was terminated all too suddenly by the death of the three insects—not as a result of the light treatments given. The results are very interesting but cannot be taken as conclusive because of the meager data obtained. They are briefly recounted merely as suggestive of new lines of study.

A quartz monochromator and mercury arc was used to supply radiation of definite wave length. This instrument gave a strip of light about 1 inch wide across the petri dish in which the insect was confined. The intensities of each wave length used were adjusted to equality, this value being 0.0005 watts to the square centimeter (1/200 total sunlight intensity), which for the yellow light was about 50 foot-candles. The white light was obtained from a 60-watt bulb and a daylight filter, the filter being used to approximate sunlight quality.

The notes taken on the reaction of these insects to the various illuminations are given in table 1.

For equal incident energy of the different wave lengths it is seen that the shorter wave lengths, violet and ultraviolet, consistently give a greater stimulus to activity. Yellow and green light give only a weak stimulus.

The shortest wave lengths used, 3,130 Å, gave the greatest stimulus—to the one insect subjected to it. The response to white light was quite striking in comparison with that for the colored light. In this case almost an equal response was observed for about one one-hundredth the intensity of the colored light.

TABLE 1.—*Reactions of wasps (Odynerus tempiferus var. nacio Bequaert) to light*

April 1, a m

Wave length	Intensity	Insect no 2	Insect no 3	Insect no 4
Å				
5,780.....	100 foot-candles (0.0005 watt/ cm <sup>2</sup> )	No response in 1 minute.	No response in 1 minute	
5,461.....	do.	do.	do.	
4,358.....	do.	do.	Definite response (1 minute)	Response
4,047.....	do.	Definite response.	do.	Definite response
3,650.....	do.	Response.	Response.	Response

TABLE 1.—*Reactions of wasps (Odynerus tempiferus var. macio Bequaert) to light*—Continued

April 1, p. m.

Wave length	Intensity	Insect no. 2	Insect no. 3	Insect no. 4
$\text{\AA}$				
5,780.....	100 foot-candles (0.0005 watt/cm <sup>2</sup> ).	Response 45 seconds after exposure.	Response 25 seconds after exposure.	Response 15 seconds after exposure; quit after 45 seconds.
4,047.....	do.....	Immediate response.	Immediate response.	Immediate response.
5,780.....	do.....	do.....	Abdominal breath- ing only.	
4,047.....	do.....			Response after 50 seconds exposure.
3,130.....	do.....	Response in 5 sec- onds; after several minutes became very active; tried to fly; stayed in illuminated strip.		
5,461.....	do.....			Breathing only; no activity in 7 min- utes.
4,047.....	do.....	Breathing after 50 seconds; active walking only after 6 minutes; tried to fly after 12 min- utes.		

April 2, p. m.

White light (day- light filter).	5 foot-candles.....			2:45 p. m.; started walking immedi- ately; studied sur- roundings in nor- mal manner.
Do.....	50 foot-candles.....			Moved from 5 to 50 foot-candles; same normal activity; tried to "dig out" of chamber.
Do.....	500 foot-candles.....	3:29 p. m.; very defi- nitely stayed in strip of light; after 8 minutes began exploring dark part of chamber.		
Do.....	8 foot-candles.....			3:44 p. m.; after 40 seconds started ac- tivity; still familiar with its chamber, explored dark re- gions.
Do.....	Less than 1/4 foot- candle.		3:53 p. m. started exploring after 2 minutes; continued for 1 minute, then rested in light for several minutes.	
Do.....	Less than 1/4 foot- candle.	About the same re- sponse as no. 3.		





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CRESTED MILLIPEDS OF THE FAMILY LYSIOPETALIDAE  
IN NORTH AMERICA, WITH DESCRIPTIONS OF  
NEW GENERA AND SPECIES

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WITH AN INTRODUCTORY ACCOUNT OF DISTRIBUTION AND SPECIALIZED CHARACTERS  
IN COLLABORATION WITH O. F. COOK, BUREAU OF PLANT INDUSTRY

STUDIES of humus faunas in different regions of the United States afford many data of geographic distribution in the several groups of arthropods that live in the soil. Most of the millipeds are definitely restricted to the humus conditions, and they afford some of the most striking contrasts in geographic distribution. The creatures that do not survive drying necessarily are confined to places where moisture is held through the dry season, and such limitations greatly restrict the distribution of species. The humus conditions prevail more widely and continuously in the rainfall regions of the Southeastern States, and in that region the species of millipeds have a relatively wide distribution, while in the arid climate of the Southwestern States localized species are the rule.

Very little of the southwestern country has continuous moisture in the soil, and favorable conditions for humus faunas usually are restricted to the higher altitudes. Wide stretches of open deserts intervene where no surface humus is found and only a few kinds of millipeds are able to exist by retreating to the burrows of the desert mammals. For most of the millipeds the deserts are impassable barriers that separate completely the more elevated districts where the animals can live. From the standpoint of the milli-

pedes, the various groups of mountains that are scattered through the southwestern deserts afford phenomena of insular restriction, like groups of islands separated by the sea.

In the family Lysiopetalidae a notable contrast is presented in the distribution of the species, between the Southeastern and Southwestern States. In the humid region to the east of the Mississippi River the family is represented by a single species, commonly known as *Lysiopetalum lactarium*, though now referred to the genus *Spirostrephon*. In the arid Southwestern States the same family group is represented by numerous local species, and among them are found remarkable structural differences that require generic recognition. Though collections have been made in widely separated districts, the results presented in this paper no doubt will prove to be only a beginning in the work of discriminating the local forms of this specialized group in the Southwest.

The Lysiopetalidae are among the more hardy and active members of the milliped group, often living among rocks in rather dry, exposed places, but in situations where it is possible to take refuge underground in the dry seasons. When the animals are disturbed their movements are rather quick, and if touched or injured they emit a defensive "repugnatorial" secretion as a whitish fluid forming a line of small beadlike drops along each side of the body. This milky secretion has a very strong and disagreeable odor, entirely different from that of the repugnatorial fluids in other groups of millipeds.

#### GENERAL CHARACTERS OF THE FAMILY

The Lysiopetalidae are associated with two groups of millipeds in the order Coelocheta, which is characterized by numerous body segments, 30 and upward; normally developed mouth parts; slender flexible antennae; well-developed eyes, except in subterranean or cave species; gnathochilarium with large stipes and a triangular mentum behind well-developed lingual laminae; a distinct median suture on all the body segments; absence of pleural sutures or distinct pleurae; free pedigerous laminae; last segment terminated by a pair of slender papilliform setigerous spinnerets; legs long and slender, the first two pairs 6-jointed, the others 7-jointed, in a few cases 8-jointed; segment 3 legless; genital openings of males in large apertures of the basal joint of the second pair of legs; copulatory organs replacing both pairs of legs of the seventh segment, preceded by seven pairs of normal legs, or with some of the anterior legs modified as accessory organs.

Three suborders of Coelocheta are recognized, the Chordeumoidea, the Striarioidea, and the Lysiopetaloidea, the last containing a single

family distinguished by a much longer and slenderer body, with more numerous segments. The other suborders have 30 segments as the normal number, with rare exceptions 26, 28, or 32 segments, while all the Lysiopetaloidea have 40 segments and upward. Another radical distinction is the presence of repugnatorial glands, which are highly developed in the Lysiopetaloidea but are wanting in the other suborders. The external openings for the ejection of the repugnatorial secretion are located on prominent lateral carinae and form a continuous series beginning at segment 6. Sculpturing of the segments into prominent longitudinal crests also characterizes the Lysiopetaloidea, especially the American members of the group. A regular alternation of larger and smaller crests is found in most of the American genera. In some of the Old World genera the crests are less accentuated.

#### SPECIALIZATIONS OF DORSAL CRESTS

In this family the numbers and arrangements of the dorsal crests are remarkably definite and constant. Generic specializations are shown by differences in relative sizes of the crests rather than in number or arrangement. The most primitive or least specialized crests may be seen in the genus *Spirostrephon*, which is distributed eastward from Texas and Arkansas and has all the crests nearly equal. All the genera from the Western States have larger and smaller crests in regular alternation, so that it is easy to distinguish at once the primary and secondary crests and to observe their differences of size and arrangement. Such comparisons are facilitated by noting the fact that in all the members of this family the median line of the segments is marked by a fine longitudinal sulcus. On each side of the median line is a small or secondary crest, then large and small crests are repeated. The lateral crest or carina that bears the repugnatorial pore is obviously different from the others. The anterior segments have four primary dorsal crests, the other segments six.

The complete and typical number of the dorsal crests, between the pore-bearing carinae, is 14. On each side of the median line are three primary dorsal crests, alternating with four secondary crests, or seven crests on each side. The full number of crests is found on the segments at the middle of the body, and the number on these segments is the same for all the members of the group. Smaller numbers of dorsal crests are found on some of the anterior segments, but a transition occurs to the full number of crests, which then remains constant. Occasional irregularities, as suppression or doubling of one or two crests of individual segments, are sometimes found, but the pattern generally is maintained with remarkable pre-

cision. The same may be said of the numbers and positions of the crests on the segments that precede those with the full number. One of the primary crests and one of the secondary crests are omitted on each side of the middle, leaving only 10 dorsal crests, instead of 14, which occasions the abrupt transition.

Not only the numbers of crests are constant, but the transition to the full number of crests takes place regularly on the same segment in each species. That the point of transition should be constant in the species would hardly be expected in view of the fact that the transition occurs in a rather wide range of positions in the different members of the family. The precision in this character seems very remarkable, since no variations have been found in the material examined. The reduced numbers of crests on the anterior segments may be considered as a specialized feature, in view of the fact that the transition occurs in different segments in several of the species. Eight different points or positions where such transitions occur have been found among the species now recognized in North America, on segments 8, 9, 11, 12, 16, 17, 18, and 19. That no specimens have been found with transitions at segments 10, 13, 14, and 15 is a further indication of definite specialization. Moreover, the species of the same genus, though not changing the number of crests at the same point, are very closely grouped, within a range of only one point in each case, as 8 and 9, 11 and 12, 16 and 17, 18 and 19. The species that carries the reduced number of crests farthest back, that is, including segment 18, has the body slenderer than the others and also has narrower and less prominent crests.

Shortening of the secondary crests, in addition to the reduction in size, may be considered as a further stage of specialization. In two of the western genera, *Diactis* and *Tynomma*, the secondary crests are like those of *Spirostrephon* in being as long as the primary crests and attaining the posterior margins of the segments, while in the two other genera, *Colactis* and *Heptium*, the secondary crests do not reach the margins of the segments, and may be only half as long as the primary crests. On the anterior segments of *Colactis* and *Heptium* the tendency to reduction of the secondary crests is carried still further. On the first four segments the secondary crests have become obsolete, or are represented by very short rudiments, while on the first segment they are entirely absent. Thus in *Colactis* and *Heptium* the first segment has only 10 crests, contrasting with 16 or 18 crests in *Tynomma* and *Diactis*. The retention of the larger numbers of crests on the anterior segments is another indication of the affinities of *Tynomma* and *Diactis* with *Spirostrephon*, rather than with the other western genera.

The shortening of the secondary crests in *Colactis* and *Heptium* is occasioned or accompanied by an excavation of the surface of the

segments along the posterior margin, between the primary crests. In some of the species the surface is lowered very abruptly at the ends of the shortened secondary crests, forming a row of small depressed scallops or recesses along the posterior margin of the segment. In one of the species of *Heptium* the stepping-down of the surface of the segment is very abrupt, and the depressions appear to be bordered in front by a narrow rim, as if the secondary carinae had divided to form the excavated areas. A similarity may be noted between such bordered areas and the ring of channeled or fluted sculpturing of the surface around the posterior half of the anterior subsegments, which suggests that the theory of metaphanic variation may apply.

#### LATERAL CRESTS

Lateral crests also are found in all the genera of Lysiopetalidae, below the crests or carinae that bear the repugnatorial pores. In all the American genera two of the lateral crests are much more prominent than the others and larger than the dorsal crests. In the genus *Spirostrephon* two of the lateral crests are especially large and as prominent as the poriferous crest, so that a lateral view of these animals gives the impression of three conspicuous lateral crests of nearly equal size. In some of the western forms the lateral crests are less developed, but detailed comparisons have not been made.

#### POSITIONS OF DORSAL BRISTLES

The regular sculpturing of the segments is supplemented by a series of bristles located in definite patterns and in specialized relations with the crests. All the primary crests, both dorsal and lateral, as well as the pore-bearing carinae, are subtended by bristles, one bristle associated with each crest. Except on a few of the anterior segments, all the bristles are inserted along the posterior margins of the segments, not directly at the ends of the crests but slightly out of line with the crest, on the side toward the middle of the body. No deviation from this posterior position of the bristles is found in any of the pore-bearing segments, including segment 6, where the pores begin.

A different arrangement of the bristles appears on segment 5 (fig. 18, *k*), where only six bristles are found along the posterior margin of the segment, three on each side of the median line, at the second, third, and fifth crests. As if to replace the missing bristles of the first and fourth crests, two other bristles are found at the front of these crests, and on the opposite side of the crests, away from the middle of the segment. On segment 4, all the bristles have the anterior position, like the two bristles that stand in front on each side of segment 5, and this arrangement obtains also on segments 3 and 2.



The first four segments have no bristles along the posterior margin, but only at the front of the crests. On the first segment the bristles no longer appear in a regular transverse line, but the 10 bristles are still found as a constant number.

The two positions of the bristles suggest that the ancestral forms of the *Lysiopetalidae* may have had two or more rows of bristles across the segments, as do some of the other groups of millipeds. The alternative view would be that the bristles belong to a single primitive row, which has changed to these different positions on the segments. The bristles possibly are older than the crests in the phylogeny of the group, so that on the anterior segments crests may have developed behind the bristles but in front of the bristles on posterior segments. The crests may have arisen from the tubercles that bore the bristles in the primitive forms. Although the bristles are now separate from the crests, they seem to be associated definitely with them.

Under the assumption of two primitive rows of bristles it would need to be inferred that the posterior row has been suppressed on the anterior segments, while the anterior bristles have been suppressed on the posterior segments. The different positions of the bristles on segment 5 would seem at first to support the assumption of two original rows, but less confidence is felt in this explanation when account is taken of the strict limitation in the number of bristles and the remarkable precision of arrangement shown at the point of transition from anterior to posterior bristles, on segment 5. If the bristles of this segment are supposed to represent two primitive rows, it is difficult to understand why neither of the rows should ever be complete, or why some of the crests, at least, should not have two bristles. So great an accuracy in the suppression of particular bristles of two original series is as difficult to credit as that the contrasted positional relationships on the different segments have developed in one row of bristles.

With either view of the development of the bristles a scarcely imaginable accuracy of adjustment of the hereditary controls of the characters has to be admitted to account for the constant number and the exact positional relations of the bristles on segment 5, to say nothing of the other segments. That the transition point should be so definitely fixed upon a single segment is sufficiently wonderful, but that it should be held at so definite a point that four of the crests of segment 5 have their bristles in front, while the other six crests have their bristles behind, is a wonder of accurate adjustment of heredity that leaves all our adjectives inadequate.

On account of the repetition of the same features in so many segments, the millipeds afford unusual opportunities for observing the precision of adjustment of the characters, as in the study of heredity in twins or in pure lines, which are supposed not to vary. With many segments the same, even slight changes of the characters are noticeable and significant, as are small deviations when using an instrument that carries a vernier.

#### SPECIALIZED CHARACTERS OF THE LEGS

The anterior legs of both sexes of Lysiopetalidae, in all the species examined, have a comblike row of bristles along the inferior face of the terminal joint. These combs are regularly present on the first and second pairs of legs, and in some cases they are found on the third pair. Extension of the combs to the third pair of legs has been noted in the females of *Spirostrephon* and in males of *Colactis* and *Heptium*.

The males of most of the species have the terminal joints of some legs provided with fleshy, pubescent pads on the under side. The number of legs so provided is not the same in the different species, and a few species lack this feature. The pads are absent in two species of *Colactis* and in the genus *Heptium*.

In all cases where the pads are found they begin on the legs immediately following those provided with combs, and all the remaining legs in front of the gonopods have pads, and at least a few of those behind the gonopods. In one species, *Diactis soleata*, the pads extend far back, within 10 or 12 legs of the end of the body. In a related species, *D. triangula*, the pads do not reach the middle segments.

Males of the genus *Diactis* have a process on the basal joint of the anterior pair of legs of many segments near the middle of the body, a feature not present in the other genera.

The seventh pair of legs of the male is specially reduced and modified in the genus *Heptium*, leaving only six pairs of normal legs in front of the gonopods. The basal joint of the seventh leg is produced into a long erect spine, standing in front of the gonopod and nearly its equal in length. The outer joints of the modified leg are very small, especially beyond the third joint, but the number of joints apparently is the same as in the normal legs. In one individual of *Heptium* a marked difference between the legs of the seventh pair was observed, one of the legs being but slightly reduced and having the spine of the basal joint replaced by a setiferous papilla. It may be inferred from this variation that the specialization of the seventh legs is relatively recent. Also it is possible to consider the development of a spine on these legs as a carry-over from the gonopods.

## 7-JOINTED AND 8-JOINTED LEGS

In *Spirostrephon*, *Diactis*, and *Tynomma* all the legs are 7-jointed, being composed of a basal or coxal joint, a very short second joint, a third joint longer than any of the three succeeding joints, which are subequal, and a seventh or outer joint distinctly longest of all. In *Colactis* and *Heptium* some of the anterior legs are 7-jointed, but all the remaining legs have an eighth joint, which is formed by a division of what corresponds to joint 7 of the first few legs. In these two genera the transition to 8-jointed legs is not always distinct, since in some females it obviously occurs on the third pair of legs, while in other females the eighth joint is not observed with certainty until somewhat farther back. In the males the first three pairs of legs are plainly 7-jointed, and in the species with the next four pairs of legs lacking ventral pads on the last joint the legs usually are seen to be 8-jointed. In males of the species with ventral pads on the last joint of some of the anterior legs, the transition to eight joints appears to take place gradually and somewhat farther back, so that only the last few pairs of pad-bearing legs and the legs thereafter may show unmistakably the eighth joint.

## SYSTEMATIC TREATMENT

## KEY TO THE NORTH AMERICAN GENERA OF LYSIOPETALIDAE

1. Segment 1 with 20 crests; anterior segments with secondary crests scarcely smaller than primary crests..... **Spirostrephon**  
 Segment 1 with less than 20 crests; secondary crests distinctly smaller than primary crests on all segments..... 2
2. Transition to full number of dorsal crests occurring on segment 8 or 9; segments 2, 3, and 4 with crests distinctly oblique and divergent, inner primary crests close to median line in front, widely separated at posterior margin; males with a small acute process projecting forward from basal joint of anterior pair of legs on numerous segments near middle of body..... **Diactis**  
 Transition to full number of dorsal crests occurring on segment 11 or later; segments 2, 3, and 4 with crests nearly parallel, or median crests slightly diverging backward; males without special processes on any of legs near middle of body..... 3
3. Transition occurring on segment 11 or 12; segment 1 with 16 to 18 crests; secondary crests as long as primary crests, reaching posterior margin of segments and remaining distinct on anterior segments..... **Tynomma**  
 Transition occurring on segment 16 or beyond; segment 1 with 10 crests; secondary crests notably shorter than primary crests, not reaching posterior margin of segments, usually obsolete on segments 2, 3, and 4..... 4
4. Transition occurring on segment 16 or 17; males with seventh pair of legs of normal size and structure..... **Colactis**  
 Transition occurring on segment 18 or 19; males with seventh pair of legs greatly reduced in size and with a long erect spine on coxa..... **Heptium**

The first member of the Lysioptetalidae discovered in North America was described by Say in 1821 under the name *Julus lactarius*. Brandt, in 1840, recognized the generic distinctness of this species from the European members of the family and placed it in a new genus, *Spirostrephon*. Many subsequent writers have treated this genus as a synonym of *Lysioptetalum* or of *Callipus*, although the error of so doing was pointed out in 1895.<sup>1</sup>

Until quite recent years no additions have been made to the family in this country since the description of *lactarium* in 1821, although in 1880 Karsch described two species of *Lysioptetalum*, supposed to have come from North America, but they probably came from some part of the Old World instead. In comparison with *lactarium*, these species were described as cylindrical, instead of depressed, with the lateral crests not stronger than the dorsal ones. In all the American species the pore-bearing carinae and two other large crests on each side of the body are more prominent than the dorsal crests. In Karsch's *Lysioptetalum setigerum* the segments are said to be clothed ("vestitis") with hairs, while in *L. costatum* the dorsal carinae are not interrupted along the front of the first segment, except that a small median area is nearly smooth.

In the present study of this family the published generic and specific descriptions of *Spirostrephon lactarium* were found to be too inadequate in details for satisfactory comparisons to be made with other North American members of the family, so that it appears necessary to include supplementary descriptions.

#### Genus SPIROSTREPHON Brandt

Body small, slender, subcylindric, slightly depressed, 25 to 40 mm long, 15 to 17 times longer than broad. Males less flattened than the females and slightly more attenuate in front.

Eyes forming a triangular cluster of 50 to 60 ocelli in 10 or 11 rows, counting from the top of the head; the adjacent sense organ about as large as an ocellus.

Antennae with joint 2 longer than any other, though not much exceeding joints 3 and 5, which are equal in length, and joint 4, which is nearly as long; joint 6 about two-thirds as long as joint 5 and about three times as long as joint 7.

First segment semicircular, with 20 longitudinal crests of uniform height along the posterior margin of the segment; the median crests about two-thirds as long as the segment, the submedian crests shorter than the middle or lateral crests; across the segment there are 10 setae arranged in a subtriarcuate series extending forward and in-

<sup>1</sup> Cook, O. F., Amer. Nat., vol. 29, pp. 1017-1019, 1895.

ward from near the hind angle on each side; counting inward the fourth seta on each side is set slightly behind seta 3 or 5.

Transition to the full number of dorsal crests occurs on segment 12.

Primary and secondary crests extending from the front margin of the posterior subsegments to the hind margin, the crests on the anterior segments subequal in size, but on the middle and posterior segments the crests are distinctly differentiated; surface between and on the sides of the crests with strong raised reticulations, the top of the crests of uniform height and moderately shining; the setae at the ends of the primary crests are short, those on the posterior segments not over a third as long as the crests.

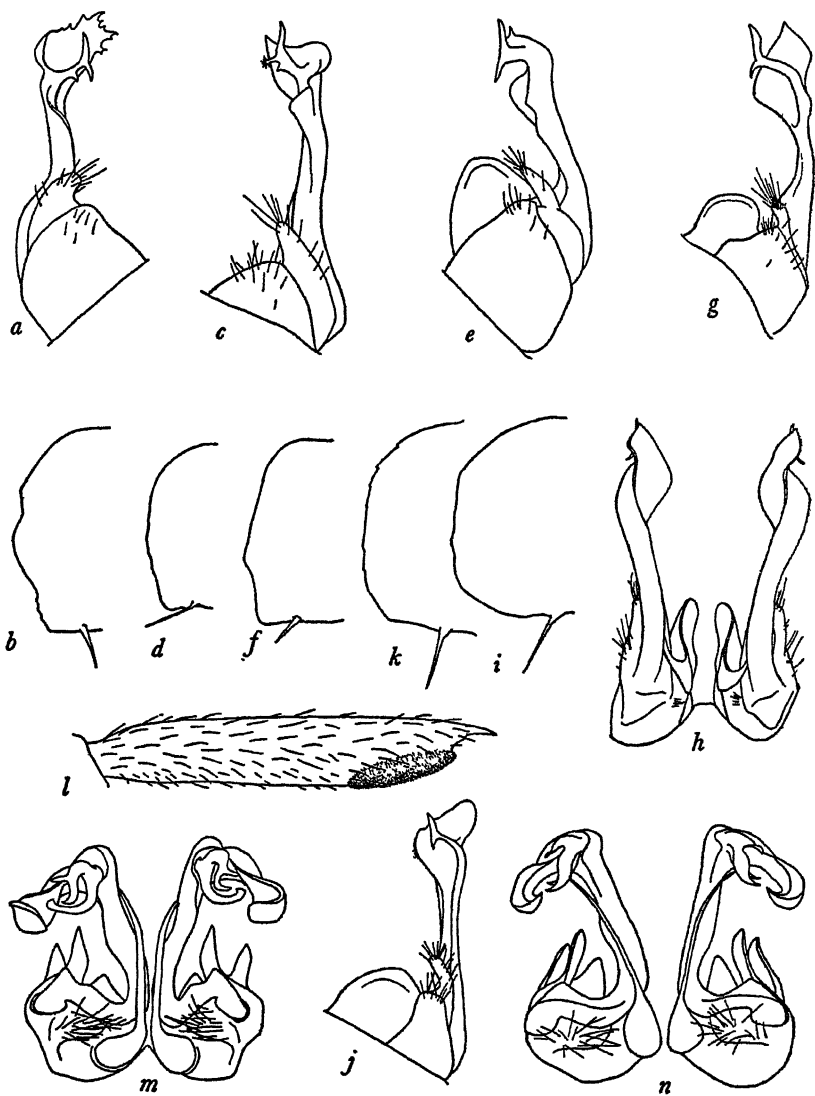
Poriferous carinae hardly more prominent than the dorsal crests; on the posterior segments the impressed poriferous area occupies only the front half of the lateral margin, but on the other segments almost the entire margin is included and the impression is elongate-elliptic in shape.

Last segment rather short, broadly truncate at apex, when viewed from above; surface without ridges but with six tuberculate setae in a biarcuate row close to the hind margin, from the thickened apical portion of which the two long papillate hairs project.

Anal valves slightly convex, the margins thin and strongly elevated.

Males with the gonopods erect, the apex of each bent sharply laterad to form a long, nearly horizontal, and subuncinate arm; from the posterior side, near the apex of the gonopod, a trifurcate process extends caudolaterad. Located behind the base of each gonopod is an oblique oval structure with the inner or upper end developed into a long and very slender cylindrical process reaching the lateral arm of the gonopod. Base of the gonopods outwardly protected by several thin, erect, shieldlike plates.

Males with a comb of fine hairs on the under side of the last joint of legs 1 and 2. Other legs in front of the gonopods, and some succeeding legs, with a velutinous pad on the lower distal half of the last joint. Females with a comb of hairs on legs 1 and 2, as in the males, and sometimes a comb on leg 3 also, but there are no velutinous pads on the succeeding legs. Coxae of all legs of both sexes normal, lacking produced lobes, although baglike structures may at times be extruded from the coxae of some anterior legs.

FIGURE 16.—Species of *Colactis* and *Spirostrephon*.

- a, b. Colactis sawetana*: *a*, Lateral view of gonopod; *b*, outline of poriferous carina from near middle of body.  
*c, d. C. baboquivari*: *c*, Lateral view of gonopod; *d*, outline of poriferous carina from near middle of body.  
*e, f. C. quadrata*: *e*, Lateral view of gonopod; *f*, outline of poriferous carina from near middle of body.  
*g-i. C. protenta*: *g*, Lateral view of gonopod; *h*, posterior view of gonopods; *i*, outline of poriferous carina from near middle of body.  
*j, k. C. sideralis*: *j*, Lateral view of gonopod; *k*, outline of poriferous carina from near middle of body.  
*l, m. Spirostrephon lactarium*: *l*, Last joint of sixth leg of male; *m*, posterior view of gonopods.  
*n. S. texensis*: Posterior view of gonopods.

## SPIROSTREPHON LACTARIUM (Say)

FIGURE 16, *l, m*

*Julus lactarius* SAY, Journ. Acad. Nat. Sci. Philadelphia, vol. 2, p. 104, 1821.

*Spirostrephon lactarium* BRANDT, Recueil de mémoires relatif à l'ordre des insectes myriapodes, p. 90, 1840.

*Platops lineata* NEWPORT, Ann. Mag. Nat. Hist., vol. 13, p. 207, 1844.

*Lysiopetalum lineata* GERVAIS, Myriapodes; in Walckenaer and Gervais, Histoire naturelle des insectes, Aptères, vol. 4, p. 133, 1847.

*Cambala lactarius* GERVAIS, *ibid.*, p. 134.

*Reasia spinosa* SAGEE, Proc. Acad. Nat. Sci. Philadelphia, vol. 8, p. 109, 1856.

*Lysiopetalum lactarium* PACKARD, Proc. Amer. Philos. Soc., vol. 21, p. 183, 1883; and others.

*Lysiopetalum eudasum* MCNEILL, Proc. U. S. Nat. Mus., vol. 10, p. 330, 1887.

*Callipus lactarius* BOLLMAN, Proc. U. S. Nat. Mus., vol. 11, p. 405, 1888; and others.

*Description*.—Length 30 to 39 mm; width 1.8 to 2.3 mm; number of segments 55 to 59.

Eyes composed of about 60 ocelli usually in 11 rows, counting downward; sense organ about the size of an ocellus, located just in front of the sixth and seventh rows of ocelli.

Antennae long, reaching to the posterior border of segment 6, at least.

First segment nearly semicircular, with 20 longitudinal crests of uniform height, those near the middle extending across the basal two-fifths of the segment.

Transition to the full number of dorsal crests occurs on segment 12.

On the anterior half of the body the primary and secondary crests are approximate in height, but on the posterior half they are differentiated. Sides of the crests and the intervals between them unevenly granulate; apex of the crests smooth and moderately shining.

Lateral carinae rather prominent; pore borne in the thickened outer margin in an elliptic impressed area, which is open in front and reaches to the posterior third or fourth of the margin, except on the posterior segments where it nearly reaches the hind angle; on the segments near the middle of the body the pore is about one-third of the way back in the impression.

Below the lateral carinae are two prominent crests, which are larger and more elevated than any of the dorsal crests; smaller crests are present lower on the sides.

Anterior subsegments with impressed longitudinal flutings on the back quarter, the flutings separated by fine beaded lines; anterior three-quarters crossed by fine, low, shining, raised lines extending back and slightly downward from the front margin; surface between the lines distinctly reticulated.

Male gonopods as shown in figure 16, *m*.

Males with a comb of fine hairs on the under side of the last joint of legs 1 and 2. Last joint of the other legs in front of the gonopods with a velutinous pad on the under side near the claw (fig. 16, *l*); smaller pads, gradually diminishing in size, are found on the last joint of several of the legs following the gonopods. Coxae of the seventh legs normal.

Females with a comb of hairs on the first two pairs of legs, as in the male, and sometimes with a similar comb on the third legs also; other legs normal.

*Remarks.*—This species has a very wide distribution, having been reported from nearly all the Eastern, Southeastern, and East Central States and also from Minnesota, Arkansas, Texas, and Louisiana; and specimens from many localities in Florida have been examined. Because of the striking external similarity of this species with *S. texensis*, making dissection of the males necessary in classifying, it seems probable that the specimens reported as *lactarium* from the more western of the above States were incorrectly identified and may have been *texensis* or another species.

**SPIROSTREPHON TEXENSIS, new species**

**FIGURE 16, *n***

*Diagnosis.*—The external features of this species are very similar to those of the eastern *lactarium*, but the male gonopods show striking differences; the curved outer arm ends in a sharp point, instead of being broadly rounded; the upper division of the subapical structure is short and simple, and not bifid near the tip; and the lower division is in two parts instead of one as in *lactarium*.

*Description.*—Body 25 to 32 mm long and 1.5 to 2 mm broad; composed of 56 to 61 segments.

The eyes usually of 10 series of ocelli, counting downward, disposed as follows: 1, 2, 3, 4, 5, 6, 7, 8, 8, 7, a total of 51 ocelli. Several specimens had 51 ocelli in 10 series, and none exceeded this arrangement. The sense organ is in front of the sixth and seventh rows of ocelli.

The impressed poriferous area of the lateral carinae is narrower than in *lactarium*, and the pore is slightly farther forward in it, being located at the anterior fourth or fifth.

Male gonopods as shown in figure 16, *n*.

Males with ventral comb of hairs beneath the outer joint of the first two pairs of legs; the other legs in front of the gonopods and 8 or 10 pairs thereafter with a velutinous pad beneath the last joint near the tip. Females with comb of hairs on the first two and sometimes on the first three pairs of legs as in *lactarium*.



*Type*.—Male, U.S.N.M. no. 1237.

*Remarks*.—The type locality is Pierce, Wharton County, Tex., where a single male was collected in December 1905 by Dr. O. F. Cook. Many other specimens were collected the same year at Wharton, Tex., on the bank of the Colorado River. In 1927 additional specimens were collected by Dr. Cook in Smith, Dallas, and Tarrant Counties, Tex.

DIACTIS, new genus

*Type*.—*Diactis soleata*, a new species from southern California.

*Diagnosis*.—From *Tynomma* this genus is distinguished by the extremely divergent inner primary crests of segments 2, 3, and 4; the more numerous ocelli; and, in the males, by the lobed coxae of the seventh legs and of the anterior legs on the segments near the middle of the body.

*Description*.—Body moderately slender, 12 to 15 times as long as broad, slightly flattened, composed of 48 to 54 segments.

Eyes triangular, composed of 35 to 48 ocelli in 6 to 9 rows; sense organ distinctly larger than an ocellus, its diameter nearly equal to the distance between the eye and the base of the antenna.

Antennae subclavate; joint 2 longest; joints 3 and 5 subequal, longer than joint 4, which is longer than joint 6; joint 7 more than half as long as joint 6.

First segment with 18 low longitudinal crests posteriorly, the median crests not extending forward beyond the basal fourth of the segment; lateral crests but slightly longer; in front of the crests 10 setae are arranged in a transverse triarcuate series extending forward and inward from near the hind angle on each side; counting from the angle the fourth seta on each side is set far behind the third seta but not quite so far behind the fifth seta, which is very close to the middle of the segment.

Segments 2, 3, and 4 with the inner pair of primary crests four to eight times as widely separated behind as in front; the two secondary crests between them small and parallel, but the other secondary crests are larger and oblique, as are the primary crests; behind segment 4 the inner primary crests are nearly parallel.

Transition to the full number of dorsal crests occurs on segment 8 or 9.

Primary crests thin and of uniform height at the apex, which is smooth; crests usually more strongly developed on the caudal segments. Secondary crests usually reaching the posterior margin of the segments, diminishing in size and becoming inconspicuous on the last segments. Sides of both primary and secondary crests and the intervals between them definitely and uniformly netted. The setae

at the back end of the primary crests a third to half as long as the crests, except on the caudal segments where they may exceed the crests in length.

Poriferous carinae projecting scarcely more than the primary crests of the dorsum; the thin-rimmed pore area elliptic and occupying the entire margin, except on a few of the first pore-bearing segments. Below the poriferous carinae are two primary crests decidedly more prominent than those of the dorsum.

Posterior margin of the anterior subsegments with a transverse series of large, shallow, slightly oblong channels, separated by fine raised lines with beaded tops; bottoms of the channels minutely netted. In front of the channels the surface is rather coarsely and distinctly reticulated, with a few smooth raised lines extending through the netting longitudinally.

Last segment narrowly rounded-truncate behind, with six setae arising from the surface, in addition to the papillate hairs in the apical margin.

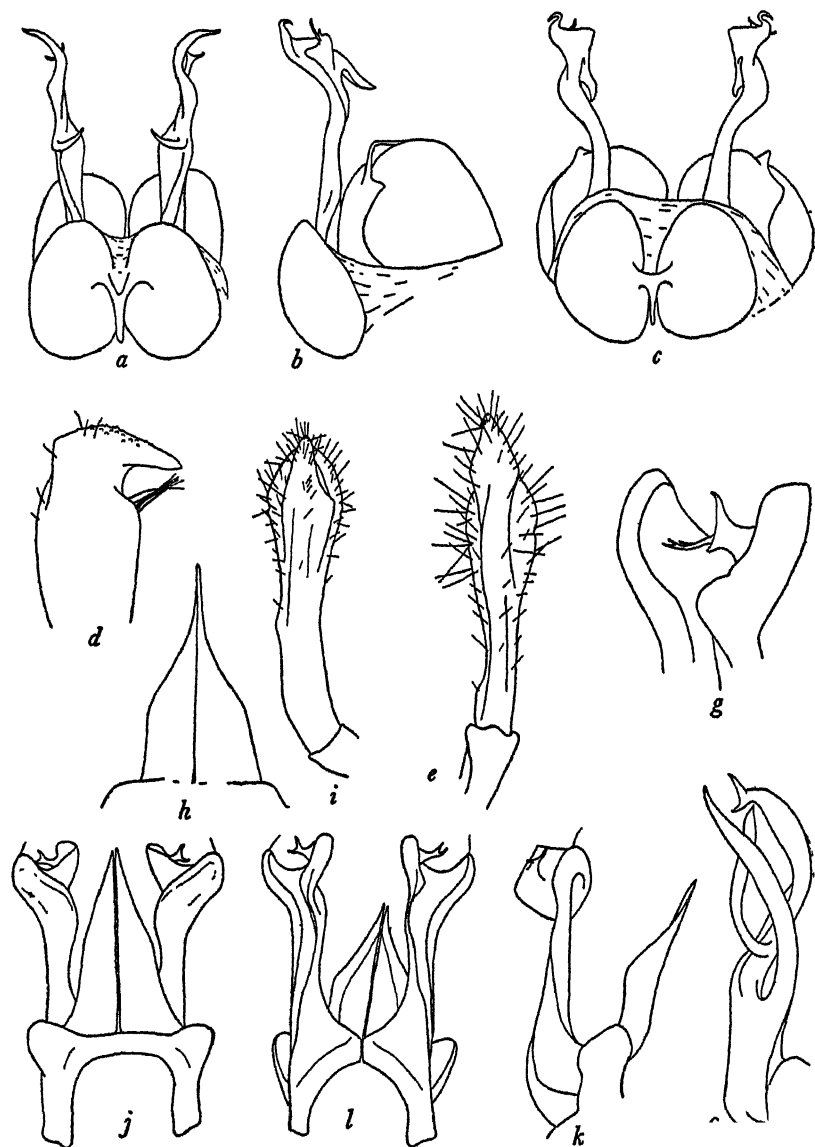
Anal valves slightly inflated, the margins thin and moderately raised.

Male gonopods consisting of two slender erect pieces variously modified, in front of which at the base there are two very large bulbous structures, more strongly chitinized on the inner side; behind the base of the erect gonopods are two large, thin, very convex shieldlike plates connected by a Y-shaped yoke, the lower part of which is produced downward and forward between the two plates; above the yoke the plates are joined by thin membranous tissue.

Female organs long and slender when extruded; the outer joint subcylindric, distinctly clavate, with the outer side rather narrowly raised and widest a short distance behind the acutely rounded apex, which extends well beyond the thicker inner portion of the joint; basal part of the joint almost completely glabrous, the apical half with many long bristles, which are less numerous on the raised outer structure except at its tip.

Males with the last joint of legs 1 and 2 with a comb of fine hairs on the under side and with the ensuing pregenital legs and some of the postgenital ones with a velutinous pad of very short hairs on the under side of the last joint; coxae of the seventh legs produced into erect, subconic lobes; first pair of legs of the segments near the middle of the body with coxae produced forward at the apex into distinct lobes, with a small dense cluster of long hairs below each lobe.

Females with a comb of hairs beneath the outer joint of only the first two pairs of legs.

FIGURE 17.—Species of *Diactis* and *Tynomma*.

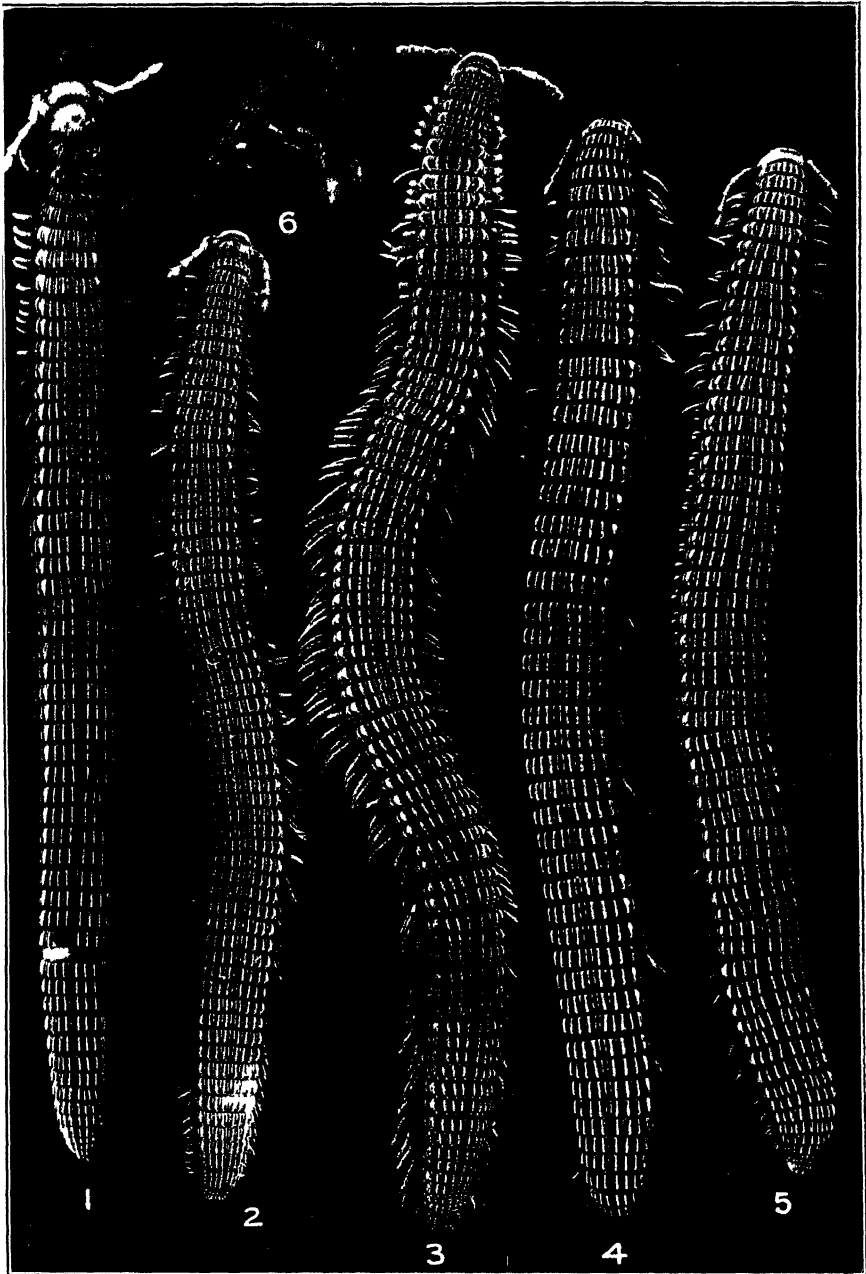
a. *Diactis triangula*: Posterior view of gonopods.

b-e. *D. soleata*: b, Lateral view of gonopod; c, posterior view of gonopods; d, inner face of coxal joint of anterior pair of legs of segment 24 of male; e, lateral view of last joint of female organ.

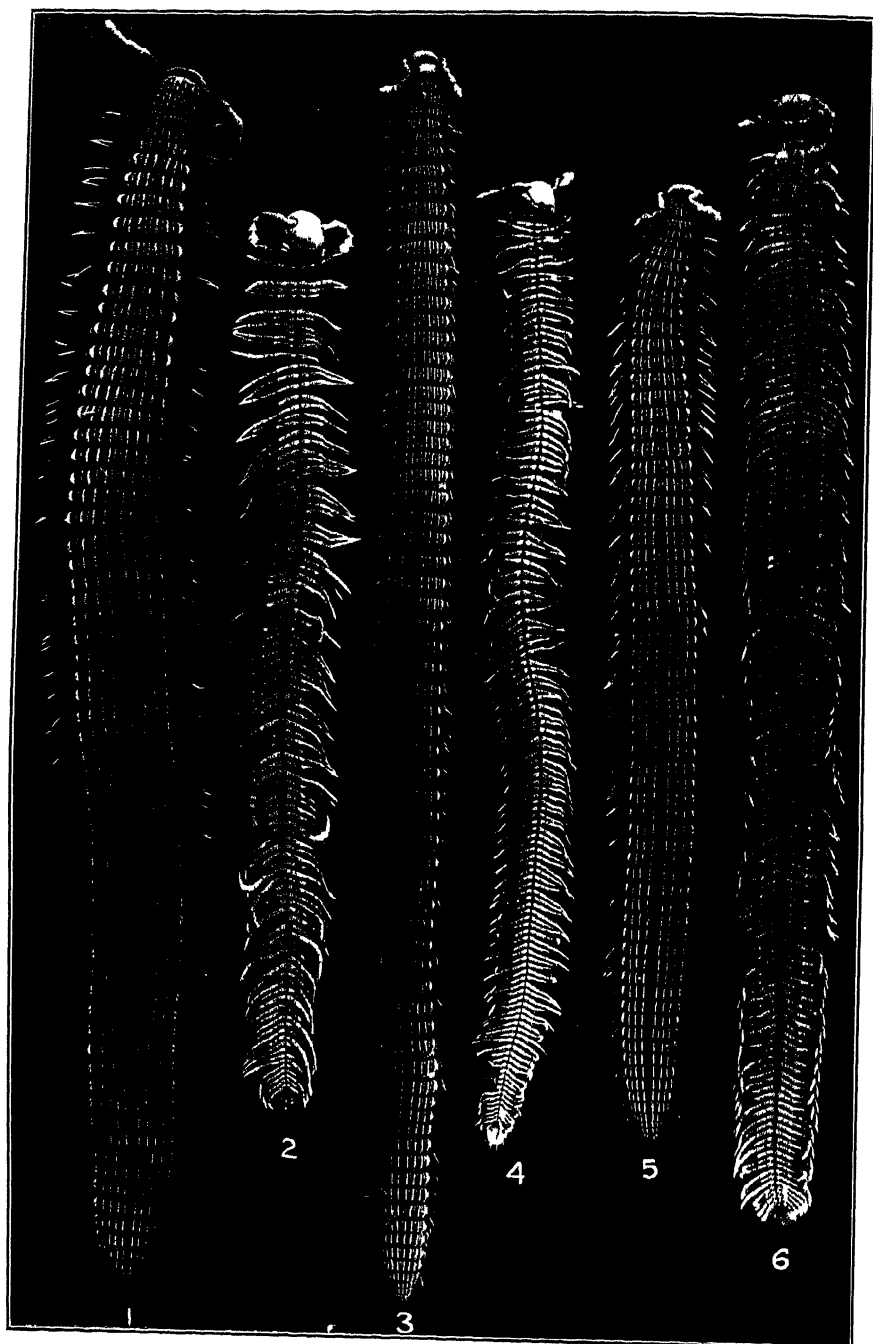
f. *D. frondifera*: Erect arm of gonopod in anterior-mesial view.

g-l. *Tynomma consanguineum*: g, Posterior view of apex of posterior gonopod; h, anterior view of anterior gonopod; i, lateral view of last joint of female organ.

j-l. *T. sedecimum*: j, Anterior view of gonopods; k, lateral view of gonopod; l, posterior view of gonopods.



1 *Diactis soleata* ♀ male  $\times 41$  2 *Coluctis sarelna* male  $\times 77$  3 *C. protenta* female  $\times 41$  4 *C. lato*  
*quatuor* male  $\times 77$  5 *C. quadrata* female  $\times 77$  6 *Ignomima sedecimum* lateral view of head, anterior  
 segments, and female organs  $\times 5$



1, *Colactis sideralis*, dorsal view of female,  $\times 5$ , 2, *C. sideralis*, ventral view of male,  $\times 5$ , 3, *Heptium carinellum*, dorsal view of female,  $\times 4\frac{1}{2}$ , 4, *H. carinellum*, ventral view of male,  $\times 4\frac{1}{2}$ , 5, *H. scamillatum*, dorsal view of male,  $\times 5$ , 6, *H. scamillatum*, ventral view of female,  $\times 5$

## DIACTIS SOLEATA, new species

FIGURE 17, *b-c*; PLATE 3, FIGURE 1

Body moderately slender, somewhat depressed; 19 to 27 mm long and 1.3 to 2 mm wide; number of segments 48 to 54 (pl. 3, fig. 1).

Eyes composed of 42 to 48 ocelli in 8 or 9 rows, counting downward from the top of the head; sense organ large, opposite the anterior ends of rows 6 and 7, or 7 and 8, and invading the triangular outline of the eye.

First segment with 18 low crests not exceeding the basal fifth at the middle of the hind margin; lateral crests scarcely longer than those at middle; inner primary crests oblique, the anterior ends almost meeting but the posterior ends widely separated; no secondary crests between the median primary crests.

Segments 2 to 4 with the inner pair of primary crests very strongly divergent on each segment, the posterior ends of the crests six to eight times as widely separated as the anterior ends. Median pair of secondary crests present on segment 2 and succeeding segments.

Transition to the full number of crests occurs on segment 8.

Primary crests more prominent on the last segments than on those in front. Secondary crests occasionally not reaching the posterior margin of the segments; the inner pair more apt to be shortened than any others. On the posterior segments the secondary crests are much fainter than on the middle segments. Setae at the posterior ends of the primary crests are longer than in any other American member of the family; nearly half as long as the crests, while on the caudal segments the setae are as long as or longer than the crests. Apex of the crests smooth and continuous; the sides of the crests and the intervals between crests marked with fine reticulations visible under strong magnification.

Poriferous carinae projecting little more than the primary dorsal crests but with the lateral margin thickened and with the impressed pore area occupying the entire margin on all but a few of the anterior segments. Pores located in front of the middle of the impression. Below the pore carinae are two primary crests, which are higher than the carinae or any of the dorsal crests.

Last segment narrowly rounded-truncate at apex, the surface without crests but with six setiferous tubercles.

Males with the gonopods erect (fig. 17, *b, c*); the lower half of each very slender; the upper half more expanded, ending in a small S-shaped hook directed forward and outward, below the hook and in front of it is a short 2-pronged arm with the prongs widely spreading; from the lower anterior part of the apical expansion a large, rather long, slightly curved and concave lobe is directed down-

ward and forward. Base of the gonopods covered behind by two thin, strongly chitinized, convex, kidney-shaped pieces joined on the inner side at the middle by a yokelike structure, above which the margins are connected by membranous tissue. In front of the base of each gonopod is a very large globular structure with the inner half chitinized, and the outer part more delicate and resembling an inflated bladder.

Apical joint of the female organs shown in figure 17, *e*.

Males with the outer joint of the first two pairs of legs bearing a ventral comb of fine hairs. Under side of the last joint of all the legs from the third pair to within 10 or 12 pairs of the posterior end of the body occupied by a velutinous pad of uniform short hairs. Seventh legs with the coxa prominently produced into an erect sub-conic lobe. The anterior pair of legs of each midbody segment has the coxal joints produced forward at the apex into a rather long, slender, shoelike lobe, below which a small dense cluster of long hairs projects obliquely upward nearly to the end of the lobe (fig. 17, *d*).

Females with comb of hairs on legs 1 and 2, similar to the males, but the other legs are without special modifications.

*Type*.—Male, U. S. N. M. no. 1238.

*Remarks*.—Two mature males and mature females collected beside the Temescal Canyon Road, near Corona, Calif., November 29, 1927, by Dr. O. F. Cook.

#### DIACTIS TRIANGULA, new species

##### FIGURE 17, *a*

*Diagnosis*.—The outstanding differences between this species and *soleata* are the less divergent primary crests of segments 2, 3, and 4; the transition to the full number of dorsal crests occurring on segment 9 instead of on segment 8; and the shorter setae on the primary crests near the middle of the body.

*Description*.—Body 18 mm long and 1 mm wide; very little depressed in the male; female not known; number of segments 49.

Eyes composed of 39 ocelli in 9 rows; sense organ much larger than an ocellus, occupying most of the space between the end of the seventh row of ocelli and the base of the antenna but not encroaching on the triangular outline of the eye.

First segment with 18 crests, those on the sides a little longer than the ones at middle, which extend across the basal fourth of the segment; inner pair of crests parallel.

Segments 2, 3, and 4 with the inner pair of primary crests rapidly diverging from in front, the posterior ends about four times more widely separated than the anterior ends; other outer crests

paralleling the inner crests. Secondary crests on either side of the impressed median line of segment 2 obsolete but appearing on the posterior half of segment 3 and conspicuous on the segments thereafter.

Transition to the full number of dorsal crests occurs on segment 9.

Primary crests more prominent on the posterior half of the body than in front, while the secondary crests become less conspicuous behind the middle and are almost entirely obliterated on the last few segments. Secondary crests adjacent to the median furrow smaller than the other secondary crests. Setae at the back ends of the primary crests shorter than in *soleata* except on the last segments, where they also equal or exceed the length of the crests. Surface between and on the sides of the crests marked with extremely fine reticulations forming lengthwise cells; the crests rather thin, the apex moderately shining.

Poriferous carinae but little more projecting than the primary crests of the dorsum, the narrowly elliptic impressed area occupying the entire margin except on several of the anterior segments where it does not quite reach the posterior corner; rim surrounding the impression thin; pore located in front of the middle of the impression. Below the lateral carinae are two primary crests higher than the carinae or any of the dorsal crests.

Last segment narrowly rounded-truncate behind; surface smooth except for six setiferous tubercles as in *soleata*.

Male genitalia simple (fig. 17, *a*), consisting of two slender erect pieces, each of which has a small uncinat process about halfway up on the outer-posterior side extending inward and slightly upward; on the anterior side about halfway between the uncinat process and the apex of the gonopod there is a small arm, divided at the tip into two prongs; apex of the gonopod erect, slender, acute. Anterior basal pieces elongate, instead of globular, as in *soleata*, highly chitinized on the inner side and in front of the erect gonopod, but inflated and bladderlike on the outer side. Posterior basal pieces much as in *soleata*.

Males with a comb of fine hairs on the under side of the last joint of legs 1 and 2; last joint of the other legs in front of the genitalia with a velutinous pad beneath, near the claw; a number of legs following the genitalia with similar pads which decrease and vanish before reaching the middle of the body. Seventh legs with coxal lobes similar in shape to those of *soleata*, but they are smaller. Anterior pair of legs on each of the midbody segments with rather long, slender, forwardly produced lobes on the coxae as in *soleata*.

*Type*.—Male, U.S.N.M. no. 1239.



*Remarks.*—A single male was collected at Cottonwood Creek, 46 miles east of San Diego, Calif., on the road to El Centro, January 22, 1921, by Dr. O. F. Cook.

**DIACTIS FRONDIFERA, new species**

FIGURE 17, *f*

*Diagnosis.*—The smaller size of the body, fewer crests on the first segment, and the slender branches of the gonopods readily distinguish this species.

*Description.*—Body 13 to 16 mm long, 1 to 1.2 mm wide, 44 to 51 segments.

Eyes composed of 35 to 40 ocelli in 6 or 7 rows, counting downward from the top of the head; sense organ in front of rows 4 and 5, or 5 and 6, in contact with the triangular eye cluster.

First segment with only 12 crests, occupying the posterior third of the dorsal surface.

Segments 2, 3, and 4 with the median pair of primary crests notably divergent, and without an intervening pair of secondary crests, the median pair of secondary crests first apparent on segment 5.

Transition to the full number of dorsal crests occurs on segment 8.

Primary crests rather strongly developed to within 4 or 5 segments before the end of the body, their tops smooth and shining; setae inserted at the posterior ends of the crests of moderate length; sides of crests and the surface between finely reticulate. Secondary crests very thin, rather weakly elevated on the anterior segments, very faint or entirely obsolete on the segments behind the middle of the body. Poriferous keels and lateral crests as in *soleata*.

Last segment smooth but for the six setiferous tubercles.

Gonopods with the erect portion (fig. 17, *f*) with three slender branches, two subapproximate at apex, the other shorter; inner branch longest, slightly curved, tapering gradually to a simple point; outer branch more strongly curved, terminating in two divergent prongs; middle branch simple, inserted near the base of the outer branch, projecting into the curve below its 2-pronged termination.

Velutinous pads present on the under side of the last joint of the male legs to well beyond the middle of the body.

Anterior pair of legs on segments near the middle of the body with distinct coxal lobes, directed forward.

*Type.*—Male, U.S.N.M. no. 1240.

*Remarks.*—A male and female collected at Torrey Pines, near La Jolla, Calif., November 1, 1925, by "Hardy." Several other females subsequently collected in the same locality by Dr. O. F. Cook.

## TYNOMMA, new genus

*Type*.—*Tynomma sedecimum*, a new species from California.

*Diagnosis*.—This genus is related to *Spirostrephon* and *Diactis* but has genitalia dissimilar to both. The smaller size; smaller eye cluster; and the greater differentiation of the primary and secondary crest of the anterior segments also distinguish it from *Spirostrephon*, while externally it differs from *Diactis* by the smaller eye cluster; the nearly parallel inner primary crests of segments 2, 3, and 4; and the normal coxae of the seventh male legs and all legs near the middle of the body.

*Description*.—Body rather slender, 14 to 15 times as long as broad, moderately depressed in both sexes; segments 46 to 53 in number.

Eye cluster relatively small, containing 22 to 39 ocelli in 6 to 8 rows, as counted downward from the top of the head; sense organ moderately large and occupying more than half of the distance between the eye and the base of the antenna.

Antennae resembling those of *Diactis* in shape and proportions.

First segment of the usual shape, with 16 to 18 distinct crests, the inner ones of two sizes like the crests of segment 2, except that between the inner pair of primary crests there are no secondary ones; lateral crests large and resembling the inner primary crests, except that they are longer and cross the posterior two-fifths of the segment. In front of the crests is a triarcuate series of 10 setae, the fourth seta on each side, counting inward, set far behind the third and fifth setae.

Segments 2, 3, and 4 with the inner pair of primary crests almost parallel, not strongly divergent as in *Diactis* but more oblique than in *Spirostrephon*.

Transition to the full number of dorsal crests occurs on segment 11 or 12.

Primary crests thin and with the apex smooth; the sides of all primary and secondary crests and the surface between them uniformly reticulated.

Secondary crests reaching the posterior margin of the segments, the crests less conspicuous on the caudal segments.

Poriferous carinae not much more prominent than the primary crests of the dorsum; lateral margin of the carinae completely occupied by the rather broad poriferous impression, except on several of the first poriferous segments where it does not extend to the posterior corner. Below the carinae are two primary crests, which are larger and more conspicuous than the dorsal crests.

Last segment narrowly rounded-truncate behind and with six setiferous tubercles in addition to the apical papillae.

Male genitalia in two distinct parts; the anterior part of two erect, thin, convex, subtriangular pieces, in contact mesially from the broad base to the acute tips; posterior gonopods erect, subcylindric, but each with a channel extending inward and upward from the outer side of the base to the apex; the apex strongly expanded and with an outwardly produced, bifurcate arm arising from the concave face of the inner lobe; under high magnification the lower branch of the bifurcate arm is seen to be equipped with several tiny appressed barbs. The large anterior and posterior pieces at the base of the gonopods in *Diactis* have no recognizable counterparts in this genus.

The ovipositors of the female, when extruded, are seen to consist of two long, indistinctly jointed appendages, with the last joint especially long and very strong clavate, thickest near the apex; the distal half of the joint with a broad, longitudinal section along the outer side gradually raised distad, the end rapidly constricted to a narrowly rounded apex which scarcely exceeds the inner, swollen portion of the joint; basal half of the joint glabrous, the apical half with moderately long, erect bristles, which are less numerous on the lateral elevation except at its tip.

Males with a comb of hairs on the under side of the last joint of legs 1 and 2; a velutinous pad occupying the under side of the last joint of legs 3 to 7, and usually several pairs following the gonopods, where the pads gradually decrease in size. Coxae of the seventh legs and of the legs near the middle of the body without special lobes such as are present on these legs in *Diactis*.

Females with a comb of hairs on the first two pairs of legs as in the male but without velutinous pads on any of the ensuing legs.

*TYNOMMA SEDECIMUM*, new species

FIGURES 17, *j-l*; PLATE 3, FIGURE 6

*Description*.—Body 15 to 18 mm long and 1 to 1.2 mm wide; with 46 to 52 segments.

Eye cluster very small, composed of only 22 to 28 ocelli in 6 or 7 rows; sense organ considerably larger than an ocellus and located in front of rows 4 and 5, or rows 5 and 6 of the cluster.

First segment with only 16 crests; excepting the uniformly large lateral crests the others alternate in size like the crests on the second segment, although there are no secondary crests between the inner pair of primary crests; median crests extending across the basal two-fifths of the segment, the two outer crests on each side nearly twice as long as the median crests.

Segments 2, 3, and 4 with the inner pair of primary crests almost parallel, very slightly spread apart behind.

Transition to the full number of dorsal crests occurs on segment 11.

On the caudal segments the primary crests are more conspicuous and the secondary crests less so than on the segments farther forward; near the middle of the body the setae at the posterior ends of the primary crests are about a third as long as the crests but on a few of the last segments the setae are as long or a little longer than the crests.

Male and female organs as described for the genus and as illustrated in figure 17, *j-l*, and plate 3, figure 6.

Males with a velutinous pad on the under side of the last joint of the five pairs of legs preceding the gonopods and on several pairs following them.

*Type*.—Male, U.S.N.M. no. 1241.

*Remarks*.—Many specimens of both sexes were collected by Dr. O. F. Cook, W. H. Jenkins, and H. G. McKeever, between Vallejo and Cordelia, Calif. (type locality), January 4, 1928, and at Cordelia and Davenport, Calif., in February 1929.

**TYNOMMA CONSANGUINEUM, new species**

FIGURE 17, *g-i*

*Diagnosis*.—This species is very closely related to *T. sedecimum* but differs in having larger eyes, two more crests on segment 1, and the transition to the full number of dorsal crests occurring one segment farther back.

*Description*.—Body of the largest specimen 18 mm long and 1.3 mm broad; number of segments 45 to 53.

Eye cluster distinctly larger than in *sedecimum*, composed of 35 to 39 ocelli in 8 rows; sense organ in front of the fifth row of ocelli.

First segment with 18 crests; no secondary crests between the median pair of primary crests; the two outer crests on each side longer than any of the other crests.

Transition to the full number of dorsal crests occurs on segment 12.

Male gonopods very similar to those of *sedecimum*, but the distal half of the erect anterior piece on each side is abruptly attenuated above the middle and the tip much slenderer (fig. 17, *h*). Posterior gonopod with a slender 3-pointed branch from the bifurcate arm, which is in the expanded apex (fig. 17, *g*).

Outer joint of the female organs shown in figure 17, *i*.

*Type*.—Male, U.S.N.M. no. 1242.

*Remarks*.—Three males and two females collected in the Santa Cruz Mountains, between Santa Cruz and Holy City, Calif., January 2, 1928, by H. G. McKeever.

## TYNOMMA MUTANS (Chamberlin)

*Lysioptalum mutans* CHAMBERLIN, ANN. ENT. SOC. AMER., vol. 3, p. 233, 1910.

This species was described from female specimens collected at Stanford, Calif., but no characters of definite generic value are given in the description. The size and shape of the eye, as shown by Chamberlin's drawing, and the locality where the animals were collected indicate that the species may belong to *Tynomma* rather than to the more southern *Diactis*, which has larger eyes. While the female organs, or ovipositors, of *mutans* do not closely resemble those of other species of *Tynomma*, they show still less similarity to those of *Diactis*. *Spirostrephon* is excluded on account of its much larger size and more eastern distribution.

## COLACTIS, new genus

*Type*.—*Colactis sawetana*, a new species from Arizona.

*Diagnosis*.—This genus, and its close relative *Heptium*, may be distinguished readily from the other American genera of this family by the presence of only 10 crests on the first segment; no secondary crests on segments 2, 3, and 4; abbreviated secondary crests on the other segments; and 8-jointed legs on all but a few of the anterior segments. In *Colactis* the seventh legs of the males are no smaller than the other legs, but in *Heptium* the seventh legs of the males are greatly reduced in size; and the full number of dorsal crests begins on segment 18 or 19, instead of on segment 16 or 17, as in *Colactis*.

*Description*.—Body of variable size and proportions; 10 to 20 times as long as broad; usually distinctly depressed, although cylindrical in one species; number of segments 49 to 89.

Eyes triangular to quadrate, composed of 30 to 52 ocelli in 6 to 9 rows; sense organ of about the size of an ocellus.

Antennae moderately long and slender; joint 2 longest; joints 3 and 5 subequal and each slightly longer than joint 4; joint 6 a little shorter than joint 4 and not over a third longer than the conic seventh joint.

First segment nearly semicircular; posterior portion with only 10 crests, in front of which are 10 setae arranged in a more or less triarcuate series.

Segments 2, 3, and 4 usually with only primary crests, but rudiments of secondary crests occasionally may be found on segment 4.

Transition to the full number of dorsal crests occurs on segment 16 or 17.

Primary crests completely crossing the posterior subsegments, somewhat thickened, the sides below the apex with one or two rows of tiny circular pits.

Secondary crests lower and thinner than the primary crests and extending from the front margin of the subsegment two-thirds or three-fourths of the way to the posterior margin, although in some species there is a tendency for some of the crests to extend to the back margin; sides of the crests below the apex usually pitted as well as reticulated; surface between both classes of crests finely reticulated.

Poriferous carinae strongly projecting, rectangular to broadly rounded in outline; pore borne near the middle of the impressed area which occupies only part of the lateral margin of all except the hindmost segments, the rim surrounding the impression is more or less thickened or inflated and with small circular pits on the sides.

Last segment broadly truncated behind; surface with 10 to 12 short setae.

Male gonopods simple, composed of two erect pieces which usually are expanded near the tip and with a 2- or 3-pronged arm at or near the apex; outer side of gonopods at base with a quadrate or subtriangular plate on each side above which there is a somewhat fingerlike process directed upward and forward, with long hairs at the apex.

Males with a comb of fine hairs on the under side of the last joint of legs 1, 2, and 3; similar combs on legs 1 and 2 of the females. The males of three species have a velutinous pad on the under side of the last joint of the legs beginning with the fourth pair, and sometimes extending back as far as the twenty-seventh pair.

First three pairs of male legs distinctly 7-jointed, the other legs more or less conspicuously 8-jointed, although in the species with pad-bearing anterior legs the eighth joint may not be distinguished until further back. Females with the first two pairs of legs 7-jointed, the ensuing legs usually plainly 8-jointed.

The species of this genus are separated in the following key:

#### KEY TO THE SPECIES OF COLACTIS<sup>2</sup>

1. Body almost cylindrical, not conspicuously flattened; short, not over 22 mm long..... *baboquivari*  
 Body noticeably flattened and over 22 mm long in specimens of average normal size..... 2
2. Body stout, 10 to 13 times as long as broad; males without a velutinous pad on under side of last joint of any of legs..... *quadrata*  
 Body slenderer, 14 to 20 times as long as broad; males with a velutinous pad on under side of last joint of fourth to seventh legs, at least..... 3

<sup>2</sup> A species to which Prof. R. V. Chamberlin gave the name *Spirostrephon utorum* has tentatively been assigned to this genus, but the original description offers no character by which the species can be definitely separated from the species in the present key.

3. Body 40 to 50 mm long; with 70 to 89 segments; poriferous carinae very broadly and evenly rounded in outline, hind angles indistinct..... **protenta**  
 Body less than 40 mm long; number of segments less than 70; poriferous carinae not so decidedly rounded, hind angles distinct..... 4
4. Gonopods with apex of each erect piece not at all expanded, when viewed from side..... **tiburona**  
 Gonopods with apex of each erect piece conspicuously expanded, when viewed from side..... 5
5. Gonopods with margin of expanded apex very distinctly and irregularly serrate; poriferous carinae decidedly irregular in outline..... **saxetana**  
 Gonopods with margin of expended apex continuous, not serrate; poriferous carinae without large irregularities..... **sideralis**

**COLACTIS SAXETANA, new species**

FIGURE 16, *a, b*; PLATE 3, FIGURE 2

*Description*.—Body slender, 21 to 33 mm long and 1.3 to 1.8 mm broad, composed of 56 to 68 segments; dorsum slightly depressed, the females more so than the males; males not appreciably more constricted behind segment 1 than the females (pl. 3, fig. 2).

Eye cluster quadrate, with 35 to 50 ocelli in 6 to 9 rows; sense organ opposite the third row of ocelli.

Segment 1 with 10 crests, the median pair of crests parallel and crossing the posterior half of the segment; anterior part of the segment, in front of the crests, faintly and sparsely tuberculate and with 10 setae arranged in a triarcuate row.

Transition to the full number of dorsal crests occurs on segment 16.

Primary crests of the dorsum prominent and only moderately thickened, highest at the posterior margin of the segment; apex uneven, subdentate when viewed from the side, and with a series of quite large, round pits on either side immediately below it. Secondary crests usually distinct but considerably lower than the primary crests and reaching across the anterior two-thirds or three-fourths of the subsegment; behind the secondary crests the surface between the primary crests gradually descends to a slightly lower level. Sides of the secondary crests, the lower sides of the primary crests, and the surface between both classes of crests roughly and irregularly reticulated, appearing almost scabrous.

Lateral carinae prominently projecting; in outline the margin is roughly rounded to well behind the middle, from where it parallels the side of the body to the right-angled posterior corner (fig. 16, *b*). Pore located in a relatively small, broadly oval area occupying the median half of the edge of the carinae of all but a few of the anterior and posterior segments; rim surrounding the poriferous impression decidedly thickened, the apex of uneven height and with a row of pits

below it on the outer side. Below the lateral carinae there are two very prominent primary crests, which are higher and more conspicuous than any on the dorsum.

Anterior subsegments with the channels on the posterior part rather shallow, noticeably longer than broad, and separated by low but distinct beaded lines; reticulations in front of the channels coarse and prominent, the longitudinal lines through the netting strongly raised.

Last segment with 10 setae in addition to the two apical papillate hairs.

Anal valves with the raised margins rather thin and strongly elevated; disk of each valve only a little inflated.

Gonopods (fig. 16, *a*) with the large expanded apical portion of each erect piece directed somewhat forward, the entire apical half with large, very uneven serrations along the margin; from the outer side of the gonopods, opposite the base of the expansion, an anteriorly directed 3-pronged arm arises; of the two apical prongs the longer points upward and the shorter points downward; below the lower prong is a still smaller prong also pointing downward.

Males with a comb of fine hairs on the under side of the last joint of the first three pairs of legs; ensuing four pairs of legs with a velutinous pad of hairs occupying the distal half of the under side of the last joint, and on five or six pairs of legs following the genitalia decreasingly smaller pads are present.

*Type*.—Male, U.S.N.M. no. 1243.

*Remarks*.—A number of specimens were collected from beneath rocks on the north slope of Picacho Mountain, between Tucson and Casa Grande, Ariz., February 7, 1926, by H. F. Loomis. Several other female specimens appearing to belong to this species have been collected at different times on a small mountain in the San Tan Range, near Sacaton, Ariz.

**COLACTIS BABOQUIVARI, new species**

FIGURE 16, *c, d*; PLATE 3, FIGURE 4

*Diagnosis*.—The short, stout, and cylindric body distinguishes this species. The gonopods indicate relationship with *saxetana*, but this is not so strongly borne out by the other characters.

*Description*.—Body short and stout, 18 to 22 mm long and 1.5 to 1.8 mm broad; cylindric, neither sex flattened; males slenderer and very slightly more attenuated behind the head than the females; segments 50 to 55 (pl. 3, fig. 4).

Eyes triangular, the 32 to 45 ocelli in 6 or 7 rows; sense organ small, not larger than an ocellus, located in front of the fourth and fifth rows of ocelli.



First segment shorter in proportion to its width than in the other species; median crests extending less than halfway to the front margin, the four inner crests closer together than the others; inner pair of crests parallel; surface smoother in front of the crests than between them.

Transition to the full number of dorsal crests occurs on segment 16.

Primary crests prominent and with a few scattered pits on the sides below the apex in an irregular row; apex somewhat thickened and of uniform height. Secondary crests conspicuous; on some of the anterior segments the median pair and occasionally some of the other crests extend to the hind margin; on the middle and posterior segments the median pair of crests extend farther caudad than any of the others, sometimes reaching the hind margin, the other crests crossing three-fifths or four-fifths of the segment; behind the secondary crests the surface of the dorsum is not lowered as in some of the other species, especially *protenta*. Surface between both classes of crests scaberulous, with indications of scattered pits.

Lateral carinae less prominent than in the other species; rectangular in outline, the front angle broadly rounded, the hind angle nearly square, sometimes a little produced backward; lateral margin continuous, scarcely rounded, paralleling the side of the body (fig. 16, *d*). Poriferous impression longer than in the other species, occupying the margin except for a short distance in front of the hind angle on all but a few anterior segments, on the foremost of which only the anterior half of the margin is occupied; rim around the impression of uniform height, not thickened, and with a few inconspicuous pits in an indefinite row on the side. Below the lateral carinae are two primary crests scarcely more prominent than the dorsal crests and no thicker.

Anterior subsegments with the posterior channels longer than broad, the intervening lines moderately high and distinctly beaded; reticulations in front of the channels distinct, the lines through them fine but somewhat more prominent than in *sawetana*.

Last segment with 10 setae on the dorsal surface.

Anal valves with the margins slightly raised and thickened, the disk of each valve not locally inflated but slightly and evenly convex throughout.

Male gonopods (fig. 16, *e*) with the expanded apical portion of each erect piece small, the tip directed forward; branched arm short and stout, arising from near the base and inside the slightly rolled expansion; arm with three apical prongs, the uppermost of which is long, pointed, and erect; the middle prong shorter, directed forward and divided at tip into 6 or 7 very small, rather short,

radiating spinules; lower prong very short, located on the under side of the arm and perpendicular to it.

Males without velutinous pads on the under side of the last joint of any legs.

*Type*.—Male, U.S.N.M. no. 1244.

*Remarks*.—Numerous specimens collected in Baboquivari Canyon of the Baboquivari Mountains, Pima County, Ariz., November 21, 1923, by H. F. Loomis.

COLACTIS SIDERALIS, new species

FIGURE 16, *j*, *k*; PLATE 4, FIGURES 1, 2

*Diagnosis*.—This species resembles *saxetana* more closely in the number of segments and the size and proportions of the body but differs in the greater number of ocelli, the shape of the lateral carinae and male gonopods, and in the greater number of male legs with a pad beneath the last joint. In these latter characters it shows some similarity with the considerably larger, more segmented *protenta*.

*Description*.—Body moderately slender, the males more so than the females and less flattened; 26 to 36 mm long and 1.8 to 2.5 mm broad; segments 55 to 68 in number (pl. 4, figs. 1, 2).

Eye cluster triangular-quadrate, with a few more ocelli than in the other species, from 48 to 56 ocelli arranged in 8 or 9 rows; sense organ in front of rows 3, 4, and 5 of the ocelli.

Segment 1 with 10 crests, the inner pair reaching the middle of the segment but not beyond, the anterior ends slightly more separated than the posterior ends; the four inner crests closer together than the outer ones; the 10 anterior setae in a strongly triarcuate series.

Transition to the full number of dorsal crests occurs on segment 16.

Primary crests of the dorsum prominent, thickened, with the apex nearly even and continuous, when viewed from the side, and with a crowded series of quite large, round pits immediately below the top on each side, and usually with a more irregular series containing fewer pits just below the top row. Secondary crests low and slender, the sides scaberulose or coarsely reticulated, as is the surface between all ridges, but lacking distinct pits. Inner pair of secondary crests reaching nearly to the posterior margin, the other secondary crests not extending onto the posterior fourth of the segment.

Lateral carinae prominent, in outline somewhat intermediate between those of *baboquivari* and *protenta*, being less broadly rounded and with a more distinct hind angle than in the latter, and more broadly rounded and with a less acute hind angle than in the former, and there are no large irregularities of the margin, as in *saxetana* and *quadrata* (fig. 16, *k*). Pore located in an elliptical impressed area occupying nearly all the lateral margin of the carinae on the

posterior half of the body, the rim around the impression very strongly swollen and with numerous scattered pits. The two primary crests below the lateral carinae distinctly more conspicuous than those on the dorsum and with the apex slightly more irregular in outline, faintly subdentate.

Anterior subsegments with the posterior channels subquadrate, very slightly longer than broad, and separated by distinct beaded lines; bottom of the channels appreciably more finely reticulated than the surface of the segment in front of them.

Last segment rather broadly rounded behind, subtruncate, with 12 dorsal setae in addition to the two apical papillate hairs.

Anal valves with the margins thinly raised, the disk of each valve strongly convex.

Gonopods somewhat resembling those of *protenta* but the expanded apical portion of each erect piece is more oblique and is broadly rounded distally; the outer arm on each erect piece is shorter and more slender, and the apposed prongs at the end are smaller (fig. 16, *j*).

Males and females with a comb of hairs beneath the outer joint of the anterior legs, as in the other species, but the males have the velutinous pads on 6 to 20 pairs of legs behind the genitalia, in addition to the four pairs immediately in front of them.

*Type*.—Male, U.S.N.M. no. 1245.

*Remarks*.—Numerous specimens collected in the Estrella Mountains, Maricopa County, the type locality, and in the Table Top Mountains, Pinal County, Ariz., February 13, 1929, by R. H. Peebles and H. F. Loomis. Many specimens also were collected in the Kofa Mountains, Yuma County, Ariz., March 31, 1930, by R. H. Peebles and H. F. Loomis, extending the range for this species over a greater area than that of any other member of the family in the Southwest.

COLACTIS PROTENTA, new species

FIGURE 16, *g-i*; PLATE 3, FIGURE 3

*Diagnosis*.—Not only is this the largest species of *Colactis*, but it is also the largest member of the family in North America, some specimens exceeding by 10 mm the largest *Spirostrephon*. Specific characters not shown by other members of the genus are the bowed inner pair of crests of the first segment, the rounded lateral carinae, and the transition to the full number of dorsal crests on segment 17, instead of on segment 16.

*Description*.—Body moderately slender, 40 to 50 mm long and 2 to 2.5 mm broad; strongly depressed, especially the females, which are not so conspicuously constricted behind the first segment as the males; segments 70 to 89 (pl. 3, fig. 3).

Eye cluster subquadrate, 42 to 52 ocelli in 6 to 9 rows; sense organ in front of the ends of the third and fourth rows of ocelli.

First segment with the inner crests extending across the posterior two-thirds, the median pair not parallel but each crest bowed out, especially in front; surface between all crests and in front of them indistinctly roughened; with 10 setae in a faintly triarcuate series in front of the crests.

Transition to the full number of dorsal crests occurs on segment 17.

Primary crests strongly thickened and of moderate height, ending in rounded-obtuse angles above the posterior margin of the segments; sides of the crests below the apex with numerous small pits arranged in two rows, the uppermost forming a nearly straight line, the lower row quite irregular; apex of the crests narrow and of nearly uniform height, only very faintly subdentate when viewed from the side. Secondary crests distinct although not greatly elevated, rather thick and reaching across the anterior three-fourths of the segment, while on the remaining fourth of the segment the surface between the primary crests descends quite abruptly to a distinctly lower level; sides of the secondary crests with an inconspicuous row of pits near the apex on either side. Surface between all the crests indefinitely reticulated but distinctly roughened and slightly shining.

Lateral carinae strongly produced, relatively more prominent than in any of the other members of the genus, very broadly and evenly rounded in outline from front to back and without distinct front or back angles (fig. 16, *i*). Pore slightly in front of the middle of the relatively short and broadly oval impressed area in the lateral margin; rim around the impressed area very greatly thickened and with two more or less uniform rows of pits on the sides. The two primary crests below the poriferous carinae are heavier and higher than those on the dorsum.

Anterior subsegments with the posterior channels especially deep and short, about as broad as long and separated by prominent beaded lines; surface in front of the channels finely reticulated, the longitudinal lines through the reticulations not especially evident and only slightly raised.

Posterior subsegments shorter in proportion to their width than in any other species.

Last segment with 12 dorsal setae in addition to the two papillate hairs in the thickened apical margin.

Anal valves with the margins moderately raised and decidedly thickened; disk of each valve definitely inflated.

Gonopods, viewed from the side, with the erect piece on each side enlarged at apex into an upward pointing leaflike expansion; from behind the base of the expansion, on the outer side, a long arm curves

up and forward and is divided at the end into two apposed, pointed prongs, the lower of which is shorter and slendered (fig. 16, *g*, *h*).

Males with a comb of fine hairs beneath the last joint of the first three pairs of legs; the under side of the last joint of the ensuing legs, sometimes as far back as the sixteenth pair, with a low, velutinous pad on the distal half except on the last few pairs of these legs where the pads decrease in size and vanish. Females with a comb of hairs beneath the outer joint of the first two pairs of legs as in the other species.

*Type*.—Male, U.S.N.M. no. 1246.

*Remarks*.—Numerous specimens collected 15 miles north of Ensenada, Lower California, on the Tiajuana Road, May 3, 1923, by H. G. McKeever. Additional specimens were found in the same locality on January 7, 1925, by H. G. McKeever and Dr. O. F. Cook.

#### COLACTIS TIBURONA (Chamberlin)

*Lysioptalum tiburonum* CHAMBERLIN, Proc. California Acad. Sci., ser. 4, vol. 12, p. 402, 1923.

It is evident that this species belongs in *Colactis* or *Heptium*, as the first segment was described as having only 10 crests; secondary crests of the poriferous segments not reaching the posterior margin of the segments; and the gonopods, as illustrated, might allow it to be assigned to either genus. As the seventh legs of the male were not described as being reduced in size the species is referred to *Colactis*, which has the seventh legs of normal size. The point of transition to the full number of dorsal crests was not stated.

#### COLACTIS QUADRATA, new species

FIGURE 16, *e*, *f*; PLATE 3, FIGURE 5

*Diagnosis*.—Closer relationship with *C. tiburona* (Chamberlin) than with any other species is indicated by the shape of the eye cluster, the size and proportions of the body, and the form of the gonopods, although these lack the slender, erect, serrate structures figured by Chamberlin for *tiburona*.

*Description*.—Body stout, noticeably depressed in both sexes, 17 to 34 mm long and 1.6 to 2.7 mm broad, composed of 49 to 61 segments (pl. 3, fig. 5).

Eye cluster distinctly quadrangular, composed of about 51 ocelli in 7 or 8 rows, counting downward from the top of the head, the ocelli distributed as follows: 5, 7, 8, 8, 8, 8, 7, or 3, 5, 7, 7, 7, 8, 7, 7; sense organ in front of rows 2 and 3, or 3 and 4, of the cluster.

First segment with the inner crests crossing the posterior two-fifths, the four inner crests decidedly closer together than the other

crests; setae in a subtriarcuate series, the six inner setae nearly in a straight line.

Transition to the full number of dorsal crests occurs on segment 16.

Primary crests high, moderately thickened, the apex smooth, continuous in lateral view, a single row of small, circular pits on each side below the apex below which the sides are reticulated.

Secondary crests lower and slenderer than the primary crests, the sides with similar punctations and reticulations; crests usually crossing only the anterior three-quarters of the subsegment, but the inner pair frequently extending to the posterior margin; surface behind the crests descending gradually to a somewhat lower level between the primary crests.

Surface between both types of crests roughly and finely reticulate as on the sides of the crests; the middle of each interval usually with a row of very tiny granules not reaching either margin of the subsegment; between the median line and the secondary crest each side is a row of similar granules which extends completely across the segment.

Poriferous carinae rather strongly projecting, the anterior angle broadly rounded, the posterior angle slightly more acute than a right angle; on the caudal segments the outline of the lateral margin of the carinae is smooth and continuous, as the poriferous impression reaches the length of the margin to the posterior corner, but on the other segments, in front, the impression occupies only part of the margin and its posterior limit is indicated by a distinct recession of the margin following it (fig. 16, *f*). Poriferous area broad and surrounded by a strongly thickened rim with pits on both sides, the apex smooth; pore located near the center of the impression. The two primary crests below the lateral carinae are somewhat heavier and more prominent than the dorsal crests.

Anterior subsegments with the posterior channels longer than broad, separated by distinct, beaded lines; bottoms of the channels very finely reticulated; in front of the channels the reticulations are very much coarser than in them, and there are prominent raised lines extending lengthwise through the netting.

Last segment broadly truncate behind; with 12 short setae on the dorsal surface and two short papillate hairs in the apical margin.

Anal valves scarcely inflated, the margins thin and only moderately raised.

Male gonopods with the erect piece on each side not expanded at the tip as in the other species with the exception of *tiburona*, but it is abruptly bent forward and ends in two prongs, one of which is directed upward, the other downward; behind the upper prong is a smaller erect subapical pointed projection; below the bend near the

extremity of the piece the surface is expanded forward mesially; basal structures of the gonopods resembling those of *protenta*, to a certain extent (fig. 16, e).

Males with a ventral comb of hairs on the first three pairs of legs, as in the other species, but none of the ensuing legs have ventral pads. Females with ventral combs on the first two pairs of legs.

*Type*.—Male, U.S.N.M. no. 1247.

*Remarks*.—Two males and three females were collected beneath rocks at the base of the cliffs in Cave Creek Canyon, Chiricahua Mountains, Cochise County, Ariz., May 25, 1928, by R. H. Peebles and H. F. Loomis.

#### COLACTIS UTORUM (Chamberlin)

*Spirostrephon utorum* CHAMBERLIN, Pan-Pac. Ent., vol. 2, no. 2, pp. 61–62, 1925.

In the original description of this species the remarks pertaining to the dorsal crests apply to nearly all the western members of the family that have been seen. Also some of the newly described species are light in color, so that this character is of incidental importance. The shape of the poriferous keels is the only character that may be of generic value and would indicate relationship with *Colactis* or *Heptium*, as does the number of segments. On the basis of the distribution of these genera it is probable that the species belongs in the genus *Colactis*, and no doubt it is different from any of the species described in this paper, although no characters are given that may be used to distinguish it.

#### HEPTIUM, new genus

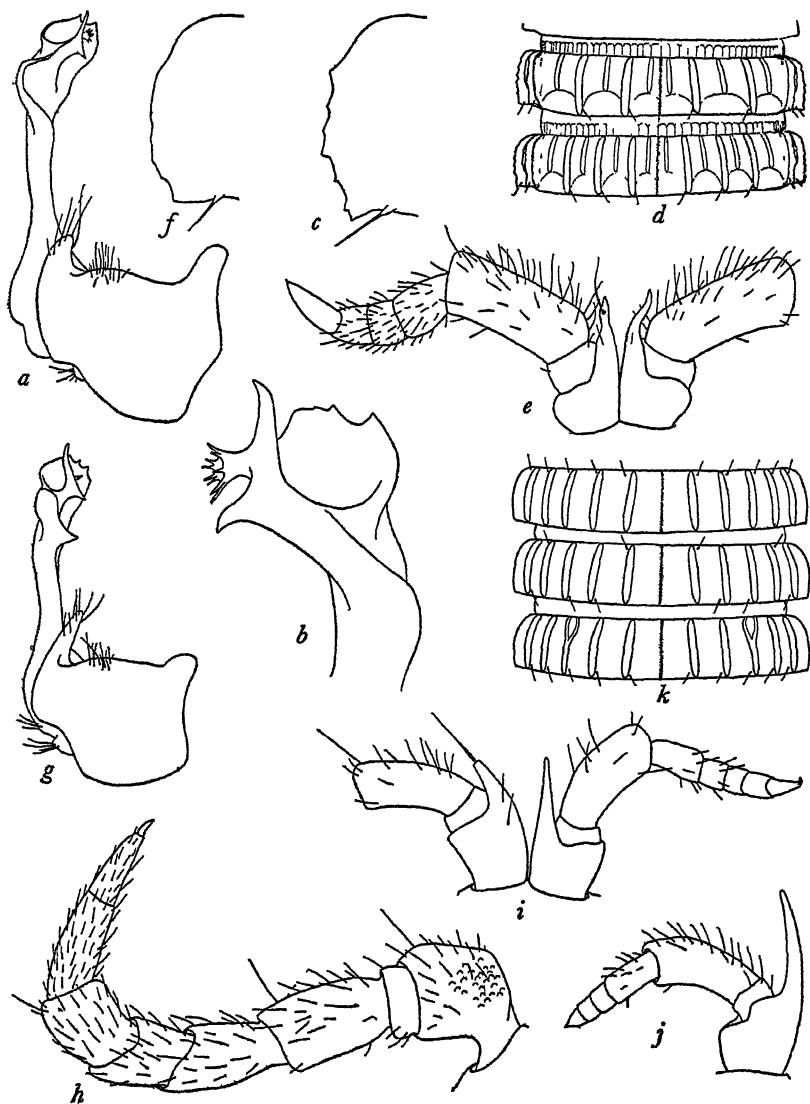
*Type*.—*Heptium carinellum*, a new species from southern California.

*Description*.—This genus is closely related to *Colactis*, but differences are mentioned in the following paragraphs.

Transition to the full number of dorsal crests occurs on segment 18 or 19, instead of segment 16 or 17, as in *Colactis*.

The outer basal portion of the male gonopods consists of a single large piece instead of two or three distinct pieces, which, when taken together, do not closely resemble the outline of the structure in *Heptium*, although a relationship is evident.

Males with seventh legs greatly reduced in size, not extending beyond the end of the fourth joint of the normal sixth pair of legs; basal joint with a long, slender, erect spine developed from the inner anterior angle and extending nearly as high as the apex of the gonopods; joint 2 very short; joint 3 much longer, equaling or exceeding in length the combined remaining joints. One male of

FIGURE 18.—Species of *Heptum*

*a-c. Heptum scamillatum* : *a*, Lateral view of gonopod ; *b*, lateral view of apex of gonopod ; *c*, outline of poriferous carina from near middle of body ; *d*, segments 17 and 18, showing transition to full number of dorsal crests ; *e*, anterior view of seventh legs of male (outer joints of one leg not drawn).

*f-j. H. carinellum* : *f*, Outline of poriferous carina near middle of body ; *g*, lateral view of gonopod ; *h*, anterior view of eighth leg of male, showing the eight distinct joints ; *i*, anterior view of reduced seventh legs of male, showing difference in size and structure of coxal spines and the full number of eight joints of the leg ; *j*, anterior view of one of reduced seventh legs of male showing greatly produced coxal spine and a total of only seven distinct leg joints.

*k*. Diagrammatic sketch of segments 4, 5, and 6 of the American species of *Lysiopetalidae*, showing the dorsal primary crests and the transition of the setae from their anterior to their posterior ends.

(*e*, *h*, *i*, and *j* are drawn to same scale.)



*carinellum* with the seventh legs 8-jointed, but the other males in both species have these legs 7-jointed.

Males with a comb of fine hairs beneath the last joint of the first three pairs of legs; none of the ensuing legs with velutinous pads such as are found in some species of *Colactis*. Females with combs of hairs beneath the first two pairs of legs.

Males with the first three pairs of legs 7-jointed and also occasionally the seventh pair, the other legs distinctly 8-jointed. Females with only the first two pairs of legs 7-jointed, the other legs 8-jointed.

**HEPTIUM CARINELLUM, new species**

FIGURES 18, *f-j*; PLATE 4, FIGURES 3, 4

Body long and very slender, loose jointed, the anterior subsegments greatly exposed in all specimens, dorsum distinctly depressed in both sexes; length 25 to 38 mm, width 1.4 to 1.7 mm; number of segments 61 to 70 (pl. 4, figs. 3, 4).

Eye cluster definitely triangular, with 29 to 46 ocelli usually in 6 rows but sometimes in 7 rows; sense organ the size of an ocellus and close to the third and fourth rows of ocelli.

First segment with 10 prominent crests, the inner ones extending almost halfway to the front margin; the third and fourth crests, counting outward from the center of the dorsum, longer than the others; surface in front of the crests not tuberculate; setae in a triarculate series.

Second segment with the dorsal crests quite thick and strongly elevated, but on the ensuing segments the crests gradually decrease in size and height, and behind the front third of the body they are lower and slenderer than in any of the other American species examined. The secondary crests, although obsolete on the first five segments, are more conspicuous on the segments immediately following than farther back, and are scarcely visible on the last few segments.

Transition to the full number of dorsal crests occurs on segment 19.

Primary crests with the apex almost a straight line when viewed from the side; on each side immediately below the apex is a single series of small, closely placed, circular pits; the lower sides of the primary crests, all the secondary crests, and the rest of the dorsal surface rather coarsely and irregularly reticulated. Behind the secondary crests the surface of the segments faintly descends to a slightly lower level.

Poriferous carinae prominent; in outline slightly irregular, with a broadly rounded anterior corner and an abrupt, nearly right-angled posterior corner (fig. 18, *f*). On the midbody segments the

pore area is short and broadly elliptic and occupies only about the middle half of the outer margin, the rim above and below the impression strongly inflated and with pits similar to those of the primary crests; pore near the center of the impression. Below the poriferous carinae are two primary crests distinctly higher than those of the dorsum and with three to six very tiny denticles along the apex.

Anterior subsegments with the posterior channels notably longer than broad and separated by strongly raised, beaded lines; reticulations in front of the channels rather coarse, the longitudinal lines through them low and fine.

Last segment with 12 setae in addition to the two papillate hairs.

Anal valves evenly convex, the margins moderately thick and elevated. Preanal scale with a broad, shallow, transverse impression near the middle, the lateral tablike processes large and conspicuous.

Each gonopod with the upright piece expanded at the apex on both sides of the pronged arm; the upper, inner expansion with three or four large serrations distally; the lower, lateral expansion extending outward and curving somewhat forward, partially concealing the base of the arm; the outer basal structure with a long and slender fingerlike process adjacent to the upright piece (fig. 18, *g*).

Males with a comb of hairs beneath the outer joint of the first three pairs of legs; these legs and usually the seventh pair 7-jointed (fig. 18, *j*), the other legs 8-jointed (fig. 18, *h*); in one male the seventh legs are definitely 8-jointed (fig. 18, *i*).

Males with the seventh legs greatly reduced in size, their tips sometimes only slightly exceeding the end of the second joint of the adjacent normal legs, but occasionally they reach opposite the end of the fourth joint of these legs; coxa with a long slender spine arising from the inner anterior corner and curving up and back to near the apex of the gonopods; in one specimen one of these spines is shortened and truncated and has a long erect seta continuing from the apex; joint 2 very short; joint 3 long, usually longer than the remaining joints combined, the outer joints being reduced in size and length.

*Type*.—Male, U.S.N.M. no. 1248.

*Remarks*.—Numerous specimens collected 2 miles east of "Indian Head", on the Indio-El Centro Road, southern California, February 2, 1929, by Dr. O. F. Cook and W. H. Jenkins. A female appearing to belong to this species was found beneath a stone in Monsen Canyon, Eagle Mountains, near Shavers Well, Riverside County, Calif., April 6, 1930, by H. F. Loomis.

## HEPTIUM SCAMILLATUM, new species

FIGURE 18, *a-e*; PLATE 4, FIGURES 5, 6

*Diagnosis.*—This is a stouter species than *carinellum*. The tuberculate anterior half of segment 1, the very abrupt descent of the surface to a lower level behind the secondary crests, and the transition to the full number of dorsal crests on segment 18 are other characteristics of this species.

*Description.*—Body not especially slender, distinctly depressed in both sexes; rather close jointed, the anterior subsegments little exposed; length 27 to 34 mm, width 1.8 to 2 mm; number of segments 64 to 69 (pl. 4, figs. 5, 6).

Eye cluster triangular, with 41 to 55 ocelli in 7 or 8 rows; sense organ in front of the fourth and fifth rows of ocelli.

First segment with the inner crests reaching nearly halfway to the anterior margin, the two outer crests on each side longer than the others. Surface in front of the crests finely but distinctly and irregularly tuberculate. Setae arranged in the usual triarcuate series.

Dorsal crests thicker and higher than in *carinellum*, and decreasing in size more slowly toward the back end of the body. Transition to the full number of dorsal crests occurs on segment 18 (fig. 18, *d*).

Primary crests with a distinct, finely dentate apex, directly beneath which on each side is an irregular row of small, almost contiguous, circular pits; the lower sides of the primary crests and the remainder of the subsegment, including the secondary crests, coarsely and very unevenly reticulated. Secondary crests prominent from segment 6 to near the end of the body; entirely lacking or greatly reduced in size on the first five segments; apex of crests irregular in outline. Behind the secondary crests the surface between the primary crests descends very abruptly to a much lower level, which continues to the back margin, giving the segments a distinctly scalloped appearance behind.

Poriferous carinae prominent; outer margin strongly and irregularly serrate; the anterior corner broadly rounded and the posterior corner acute and somewhat produced backward (fig. 18, *c*); rim surrounding the pore area decidedly thickened. On the midbody segments the pore is located a little behind the center of the rather broadly elliptic impression which occupies considerably more of the margin than in *carinellum*. The two primary crests below the poriferous carinae higher than those of the dorsum and with 6 to 10 conspicuous teeth or serrations along the apex.

Anterior subsegments not so greatly exposed as in *carinellum*, and with the posterior channels a little deeper.

Last segment with 14 setae in addition to the two papillate hairs.

Preanal scale shorter and less acute than in *carinellum*.

Each gonopod with the inner, apical expansion of the erect piece having only two or three serrations; lower lateral expansion less developed and not curving forward and partially hiding the base of the pronged arm as in *carinellum*; middle structure of the pronged arm ending in 8 to 10 tiny, obliquely radiating spines or points; outer basal structure of the gonopod with a short and stout fingerlike process adjacent to the erect piece (fig. 18, *a, b*).

Seventh legs of the two males more normal in appearance than in *carinellum* but also reduced in size and with the last joint not reaching beyond the end of the fourth joint of the adjacent legs; spine of the coxa shorter than in *carinellum* and not curving forward toward the tips of the gonopods; joint 3 as long as the four remaining outer joints combined (fig. 18, *e*).

*Type*.—Male, U.S.N.M. no. 1249.

*Remarks*.—Two males and two females collected between Perris and Elsinore, Calif., February 3, 1929, by Dr. O. F. Cook and W. H. Jenkins.





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## NOTES ON PHALLOSTETHID FISHES

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VARIOUS notes on the remarkable little fishes of the Malayan family Phallostethidae accumulated while I was in charge of the division of fishes of the United States National Museum, and it seems opportune to publish them at this time. Most of the material reported on is in the National Museum.

In a recent paper (Myers, 1935, p. 6) I erected a new suborder, Phallostethoidea, for this family, which I placed next to the Mugiloidae and the Polynemoidea in the Percosoces. The recent work of Bailey (1936) appears to uphold my conclusion that the Phallostethidae are not cyprinodonts. The following synopsis of the genera, based largely on the priapium of the male, will replace that given in my 1928 paper:

### SYNOPSIS OF THE GENERA OF PHALLOSTETHIDAE

$\alpha^1$ . Toxactinium present, a shieldlike pulvinulus covering its base.

$b^1$ . Anal fin very long, of 26 to 28 rays; the single ctenactinium serrated; jaws equal or lower slightly included; first dorsal not described; abdomen of female with a groove. Phallostethus Regan

$b^2$ . Anal fin moderate, of 14 or 15 rays; the single ctenactinium not serrated; lower jaw projecting; first dorsal of one ray; abdomen of female without groove. Phenacostethus Myers

- $\alpha^2$ . Toxactinium absent; pulvinulus if present small and not shield- or disk-shaped.
- $\alpha^1$ . First dorsal fin represented by at least one ray; nape and opercles scaleless.
- $\beta^1$ . One long ctenactinium present.
- $\beta^2$ . Ctenactinium thin and considerably curved, without a membranous fold along its edge; priapium, in region of infrascular prominence, lacking a flat, many-spined process; posterior border of priapium with a series of soft, comblike projections.....*Neostethus* Regan
- $\beta^3$ . Ctenactinium not greatly curved, with a broad membranous margin along lower side of its proximal half; region of infrascular prominence with a large, flat, fleshy process armed on its upper and posterior border with 9 or 10 short, sharp, recurved spines and on its anterior border with 2 longer spines directed forward; posterior end of priapium without comblike appendages.....*Plectrostethus* Myers
- $\beta^4$ . Two long ctenactinia present; no comblike appendages at end of priapium.
- $\gamma^1$ . Pulvinulus plainly evident externally as an oval prominence with a depressed center, on aproctal side of priapium; body extremely slender and elongate; brackish-water fishes.....*Ceratostethus*, new genus
- $\gamma^2$ . Pulvinulus not evident externally; body moderately heavy; hill-stream fishes.....*Gulaphallus* Herre
- $\epsilon^2$ . First dorsal fin absent; 2 ctenactinia, the lesser one very short; nape and opercles scaly.....*Mirophallus* Herre

### Genus PHALLOSTETHUS Regan

#### PHALLOSTETHUS DUNCKERI Regan

No further specimens of this species, which was described from Johore, have been reported since Regan's original description.

### Genus PHENACOSTETHUS Myers

#### PHENACOSTETHUS SMITHI Myers

*Neostethus lankesteri* (not of Regan) H. M. SMITH, 1927, p. 353 (Bangkok, Siam); 1929, p. 13 (Bangkok, Siam).

*Phenacostethus smithi* MYERS, 1928, p. 6 (Bangkok, Siam).—BAILEY, 1936 (anatomy).

This minute species is represented by several hundred specimens in the collections of the United States National Museum (nos. 88659, 88667, 93506, 93507, 93508), as well as paratypes of the species (nos. 92297, 92979). All were collected in canals in the city of Bangkok, Siam, by Dr. Hugh M. Smith. This is the only phallostethid present in Dr. Smith's Bangkok collections, and there is no doubt that it is the species he reported in 1927 as *Neostethus lankesteri*. *P. smithi* is known from no locality other than within the city limits of Bangkok.

## Genus NEOSTETHUS Regan

## NEOSTETHUS LANKESTERI Regan

This species is known only from the types.

## NEOSTETHUS AMARICOLA (Villadolid and Manacop)

*Gulaphallus amaricola* VILLADOLID and MANACOP, 1934, p. 194, pl. 1 (Pasay, Rizal Province, on Manila Bay, Luzon; in brackish sloughs).

This species has only recently been described, although it was mentioned several years ago (Myers, 1928, p. 11). The U. S. S. *Albatross* obtained what I take to be this form at several localities in Luzon and Leyte, all apparently brackish-water habitats. There are three males from a fish pond at San Antonio, Cavité, Manila Bay (U.S.N.M. no. 98833); two males from the mouth of the Palani River, Port San Vicente, at the northern end of Luzon (U.S.N.M. no. 98834); six immature specimens from the Ragay River, Ragay Gulf, on the south coast of Luzon (U.S.N.M. no. 98835); and one male and three females from brackish water in the river at Port Dupon, Leyte (U.S.N.M. nos. 98836 and 98837).

This species is very close to *N. lankesteri*, differing chiefly in the presence of two (instead of one) rays in the first dorsal fin and slightly but sharply in the structure of the priapium in the region of the infrasulcar prominence. *N. lankesteri* has two projections in this region, the seminal papilla and the infrasulcar prominence; *N. amaricola* appears to have but one, which Villadolid and Manacop call a "penislike structure." This bears one short spine, which they identify as a second ctenactinium. I am inclined to doubt this identification; very likely this small spine is the homologue of the papillary bone that supports the seminal papilla in *N. lankesteri*. At any rate, this sharp external spine serves to distinguish *N. amaricola* immediately from its close relative.

## NEOSTETHUS SIAMENSIS, new species

*Holotype*.—U.S.N.M. no. 102140, a female 28.7 mm in standard length, collected in the estuary of the Chantabun River, southeastern Siam, in April 1933, by Dr. Hugh M. Smith.

Before his return from Siam, Dr. Smith sent me this single female as a phallostethid of a type entirely new to him. Only this one specimen was obtained. While in most cases it is not possible to determine the genus of fishes of this family without male specimens, the general habitus of this example makes me think it is probably closely related to *Neostethus*, even if it is not a member of that genus. The compressed, deep body distinguishes it immediately from the specimens of *N. amaricola* recorded above. Judging from



Regan's descriptions and figures of *N. lankesteri*, which has only one first dorsal ray (see Myers, 1928), I do not think it can be that species. I do not believe that it can be placed in any other genus of Phallostethidae. This is the second species of phallostethid known from Siam, and its discovery close to the Cambodian border makes it appear certain that fishes of this family occur in Indo-China.

*Description*.—First dorsal fin II. Second dorsal I, 5. Anal I, 15½. Pectoral 12. Caudal with 12 branched rays and several unbranched supporting rays above and below. Scales mostly lost, but 31 pockets can be counted from head to caudal base. Nape and head scaleless. Transverse scales between mid-dorsal series and abdominal keel, at deepest part of body, 7. First dorsal origin over base of eleventh branched anal ray. Origin of second dorsal over base of last anal ray. Pectorals long and pointed, the upper rays longest, reaching two-thirds of the distance from the upper part of the fin base to the origin of the anal fin. Caudal forked.

Measurements in millimeters (taken from point to point, as indicated, with dividers, and not as to the vertical on the axis of the fish): Standard length 28.7. Depth (less abdominal keel) 6.3. Head 5.5. Snout tip to origin of second dorsal fin 23.0. Snout tip to origin of anal fin 16.5.

Anus and postanal papilla very similar to those of *N. lankesteri* (see Regan, 1916, p. 16, fig. 12b). The papilla is less strongly bifid than in that species, but, like it, one of the halves (left) is better developed. This may have some bearing on the occurrence of "rights" and "lefts" among the males.

Color (specimen fixed in formalin) pale yellowish, probably translucent in life. A black hair-line marking the division between the epaxial and hypaxial trunk muscles from head to caudal. Another fine black line along base of anal fin and middle of lower surface of caudal peduncle to caudal fin. Above this line, on the anal base, is another fine black line marking the junction of the body muscles and the supports of the fin. A few black chromatophores along the dorsum, a large patch on the occiput, another patch on the upper surface of the snout, and one on the lower part of the pectoral girdle. Other melanophores are dusted along the sides of the snout and jaws, in a segment of a circle behind the eye, and on either side of the anus and postanal papilla. Fins hyaline.

*Remarks*.—There is a distinct possibility that this fish is identical with *N. lankesteri*, although only one first dorsal ray is reported for that species. If Regan's figure (Regan, 1916, pl. 1, fig. b) of *N. lankesteri* is correct in its proportions, which I see no reason to doubt, *N. siamensis* differs otherwise in the greater depth and the much more posterior positions of the dorsal and anal fins.

## Genus PLECTROSTETHUS Myers

## PLECTROSTETHUS PALAWANENSIS Myers

*Plectrosethus palawanensis* MYERS, 1935, p. 5 (mouth of the Caiholo River, Ulugan Bay, west coast of Palawan).

This slender little species has the most strongly rectilinear body form of any phallostethid. That it has breeding habits similar to *Gulaphallus* and *Phenacostethus* is indicated by a grapelike cluster of eggs that was still attached to the vent of one of the females when I first examined them. These eggs are now U.S.N.M. no. 93424.

## CERATOSTETHUS, new genus

*Genotype*.—*Neostethus bicornis* Regan.

Outside of *Phallostethus*, the fishes of this new genus are the slenderest of all the phallostethids. The "neck" in particular is exceedingly slender. In this, and in their brackish-water habitat, they differ strongly from the two known species of *Gulaphallus*.

## CERATOSTETHUS BICORNIS (Regan)

*Neostethus bicornis* REGAN, 1916, p. 14, fig. 11 (Kuala Langat, Selangore).—MYERS, 1928, p. 9 (compiled).

This form has been known hitherto only through the three immature type specimens in the British Museum. Besides eight adults collected by Dr. A. W. Herre in brackish water in the northeastern end of Singapore Island (U.S.N.M. no. 102142), the National Museum has six adults collected by the U. S. S. *Albatross* at Nakoda Bay, on the west coast of the island of Palawan (U.S.N.M. nos. 98838 and 98839) and a single adult from the Malampaya River, Palawan (U.S.N.M. no. 98840).

There is little difference between the adult males and the subadult figured by Regan (1916, p. 15, fig. 11b), except in the more pendulous posterior end of the priapium, the better-developed oval pulvinulus, the more pointed opercle, and the better development of the two ctenactinia. The smaller ctenactinium is little longer than on Regan's fish but more slender and curved. The longer ctenactinium is curved upward, downward, and around the chin. There are two rays in the first dorsal, and the second dorsal appears to have only 4 or 5 rays. Despite the fact that only one first dorsal ray has been found in the types, I feel certain that these Singapore and Palawan fishes are the same species.

The anus of the female is surrounded by many folds of loose tissue, this area being larger than in *Neostethus lankesteri*. I do not, however, find what I am certain is a homologue of the postanal papilla of that species. The oviduct (and ureter?) appear to open

at the end of a median tubelike structure some distance behind the anus. On each side of this structure is a longitudinal ridge. In the Palawan females these lateral ridges, as well as the median lower edge of the tubelike median organ, each bear a row of exceedingly minute spines; the preservation of the Singapore specimens is so poor that I cannot be sure of the presence of these spines in them.

**Genus GULAPHALLUS Herre**

**GULAPHALLUS MIRABILIS Herre**

Villadolid and Manacop (1934) have given an interesting account of the habits, breeding, embryology, and the ontogeny of the external features of the priapium in this species (see Herre, 1925), based on studies of examples obtained in Molawin Creek, Laguna de Bay, near the College of Agriculture of the University of the Philippines. From this it is evident that the ctenactinia are used as claspers, that fertilization is internal, and that the eggs are deposited to hatch externally. Smith (1927) had observed that the eggs are deposited and not hatched within the female in *Phenacostethus*, but he apparently made no observation on the copulation.

Bailey (1936) gives a detailed account of the osteology of this species. I have examined numerous specimens of this species from Molawin Creek, sent to me by Dr. Villadolid.

**GULAPHALLUS EXIMIUS Herre**

Of this fresh-water species (see Herre, 1925), the largest and bulkiest of the phallostethids, I have examined two topotypes, adult male and female, collected by Dr. Herre in 1931 in a brook near Santa Fé, Nueva Vizcaya Province, Luzon. They are in the collection of Stanford University.

**Genus MIROPHALLUS Herre**

**MIROPHALLUS BIKOLANUS Herre**

The three cotypes of this species (Stanford University no. 24475), described by Herre (1926), that I have examined are immature and in poor condition. There is no vestige of the first dorsal fin.

#### LITERATURE CITED

BAILEY, RALPH J.

1936. The osteology and relationships of the phallostethid fishes. Journ. Morph., vol. 59, no. 3, pp. 453-483, 1 fig., 4 pls.

HERRE, ALBERT WILLIAM.

1925. Two strange new fishes from Luzon. Philippine Journ. Sci., vol. 27, pp. 507-513, 2 pls.  
1926. Four new Philippine fishes. Philippine Journ. Sci., vol. 31, pp. 533-543, 3 pls.

MYERS, GEORGE SPRAGUE.

1928. The systematic position of the phallostethid fishes, with diagnosis of a new genus from Siam. Amer. Mus. Nov., no. 295, 12 pp., 2 figs.  
1935. A new phallostethid fish from Palawan. Proc. Biol. Soc. Washington, vol. 48, pp. 5-6.

REGAN, CHARLES TATE.

1916. The morphology of the cyprinodont fishes of the subfamily Phallostethinae, with description of a new genus and two new species. Proc. Zool. Soc. London, 1916, pp. 1-26, 15 figs., 4 pls.

SMITH, HUGH MCCORMICK.

1927. The fish *Neostethus* in Siam. Science, new ser., vol. 65, pp. 353-355.  
1929. Notes on some Siamese fishes. Journ. Siam Soc., Nat. Hist. Suppl., vol. 8, no. 1, pp. 11-14.

VILLADOLID, DEOGACIAS V., AND MANACOP, PORFIRIO R.

1934. The Philippine Phallostethidae, a description of a new species, and a report on the biology of *Gulaphallus mirabilis* Herre. Philippine Journ. Sci., vol. 55, no. 3, pp. 193-220, 5 pls.





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# THE DEEP-SEA ZEOMORPH FISHES OF THE FAMILY GRAMMICOLEPIDAE

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THE RARITY of the strange oceanic fishes of the family Grammicolepididae, together with the unique character of their vertically attenuated scales, has placed them among the greatest desiderata of ichthyological collections. The four nominal species have been referred to three genera, but no previous writer appears to have examined more than one of them. Moreover, the type and supposedly the only known specimen of the first-discovered species seems to be lost, and Poey's original description of it has been misinterpreted.

It is therefore of interest to find a fine specimen of Poey's species in the collections brought back by the Johnson-Smithsonian deep-sea expedition, as well as three examples of *Xenolepidichthys dalgleishi*, a species hitherto known only from South Africa, among the fishes collected by the U. S. S. *Albatross* in the Philippines. Prof. Albert E. Parr has been kind enough to allow me to examine Mowbray's types of *Grammicolepis squamilineatus* in the Bingham Oceanographic Collection at Yale University and to bring two of the paratypes to Washington for comparison. Finally, I have had at hand Jordan's type of *Vesposus egregius*, from Hawaii.

This material is more varied than that examined by other writers, and it has enabled me to determine that the known specimens of the

family belong to only two species, each of which appears to have a world-wide distribution in the depths of tropical and semitropical seas.<sup>1</sup>

Unfortunately, the rarity of the material in my hands and the necessary apportionment of the Philippine *Albatross* fishes to three institutions have not permitted the desired osteological re-investigation of the family. It is to be hoped that future specimens will allow of this.

### Family GRAMMICOLEPIDAE

Grammicolepidi POEY, 1873, p. 405 (description).

Grammicolepididae GILL, in Kingsley, 1885, p. 207 (name only).—GILL, 1893, p. 134 (name only).—GOODE and BEAN, 1895, p. 213 (description).—JORDAN and EVERMANN, 1896, p. 973 (description).

Grammicolepidae SHUFELDT, 1888, p. 274 (translation of Poey's paper).—JORDAN, 1905, vol. 2, p. 249 (brief mention); 1923, p. 171 (name and included genera).—BARNARD, 1925, p. 370 (description).

Zeidae (part) BOULENGER, 1902, p. 300 (critical remarks).—REGAN, 1910, p. 483 (critical remarks).—WEBER, 1913, p. 409 (remarks).

The true relationship of the family Grammicolepidae was not appreciated at first. Poey asserted that *Grammicolepis* was related to the Berycidae and the Carangidae. Shufeldt agreed with Poey in relating the fish to the carangids, but he noted many important differences in the skeleton. In 1885 Gill placed the grammicolepids, along with *Lampris*, *Luvarus*, *Mene*, *Kurtus*, *Capros*, and *Zeus*, as a distant ally of the Scombroidea. His inclusion of the Caproidae and Zeidae in this category does not seem to imply that he had any distinct understanding of their closeness to *Grammicolepis*. In 1893 Gill placed the Grammicolepidae, together with most of the fishes mentioned above, in his group Scombroidea, but he stated that this assemblage was not a natural group and would doubtless be split up after further study. Goode and Bean and Jordan and Evermann merely left *Grammicolepis* where Gill placed it.

Boulenger appears to have been the first to recognize the really close similarity of *Grammicolepis* to the Zeidae, and he placed it in that family. Regan similarly placed it in the Zeidae, mentioning particularly its resemblance to the genera *Cyttus* and *Neocyttus* in the presence of the basisphenoid and in the prominence of the supraoccipitals.

The genera that are now usually referred to the Zeidae, although few in number, seem to me to be considerably divergent in many de-

<sup>1</sup>J. L. B. Smith (1931, p. 145, 2 figs.) has recently described a supposed new genus and species of South African grammicolepids as *Prionolepis hewitti*. I am indebted to Dr. Smith for the information that he now considers this fish to be a juvenile acanthurid.

tails, and I am inclined to think that there may be more than one family type among them. *Neocyttus* and *Cyttomimus* are certainly greatly different from *Zeus*, *Zen*, *Zenopsis*, and *Cyttus*. The grammicolepids are not particularly close to either of these groups in form and a number of minor details, and their scales are so vastly different that, for the present at least, I do not hesitate to give them family recognition. The final word as to their exact place must await a much-needed systematic and osteological investigation of all the zeomorph fishes.

The Grammicolepidae may, then, be defined as Zeomorphi (see Regan, 1910) in which (1) the scales are vertically linear in form, (2) the mouth is small and nearly vertical, (3) the maxillary is extremely short, (4) the anterior trunk muscles just reach the posterior edge of the frontals, (5) the occipital crest is thin, (6) the gills are  $3\frac{1}{2}$ , with no slit behind the last, (7) the branchiostegals are 7 in number, (8) the caudal fin is composed of 13 branched rays with one main and several supplementary unbranched rays both above and below, and (9) the pelvic fins are I, 6.

Gill arches thin, with one thin double row of hemibranchs. The interior, or concave side, of each arch is smooth. Both the anterior and posterior faces of each arch except the last possess a series of low cross ridges, horizontal, or rather perpendicular, to the main line of the arch. These short ridges are studded with spines. On the posterior side of the inner (concave) ramus of the first arch there is a row of small papilliform projections that might be construed as gill rakers. At the upper end of each arch, where it curves around forward, the hemibranchs leave the arch proper and run up on the wall of the gill chamber. The gill structure in the two genera is identical, but it cannot be properly seen without excising a complete arch from a specimen. There is no slit behind the last gill.

Pseudobranchiae of large size are present at the upper end of the outer wall of the gill chamber. In some specimens the filaments are entwined with those of the first gill arch, but they may be separated by a little manipulation. I believe that either this or injury in probing accounts for Barnard's statement that *Xenolepidichthys* lacks pseudobranchiae. All four examples of this genus before me have them.

Branchiostegal rays 7 in number, the first three attached to the anterior limb and the last four attached to the posterior limb of the ceratohyal, as in *Zeus*. Poey, in speaking of *Grammicolepis*, says, "no he podido descubrir más que cuatro radios branquiostegos, sin poder asegurar que no haya mayor número." Evidently he thought there might be more than four; his skeleton of the type



seems to have been in an incomplete condition, from Shufeldt's remarks. Shufeldt did not mention the branchiostegals; they were probably entirely gone when he received the specimen. Barnard gave four branchiostegals for *Xenolepidichthys*. I myself thought this was correct until I dissected the muscle overlying the first three.

The frontal and nasal bones are prominent and are covered with rows of fine blunt spines. The preorbital is prominent and its outer face is rough with the spine-studded fluting of what appear to be mucous channels. Cheeks, opercle, subopercle, and, in *Grammicolepis*, the interopercle, scaled. Vertical and lower limbs of preopercle rough with fine granules. On the upper corners of the cheeks (in the postorbital region) and opercles, along the predorsal line, at the pectoral base, and on the caudal peduncle, the rough linear scales approach the proportions of normal scales.

A row of thin, bony bucklers, each bearing a main spine (and, anteriorly at least, one or more smaller, supplementary spines) extends along each side of the entire base of the dorsal and anal fins.

Eyes large, much greater than interorbital. Body deep and strongly compressed. Caudal peduncle slender. Pectoral fins small. Anal spines 2, separated by an interspace from the first soft ray. Soft dorsal and anal rays unbranched. Greatest body depth at origin of dorsal fin.

Teeth small, acicular, weak, in a single series on each jaw.

Besides a 43 mm specimen of *Xenolepidichthys* (see Smith, 1935), which retains some postlarval characters, no larvae or postlarvae of Grammicolepidae are known. The "*Acronurus*" larvae of the Acanthuridae, with their vertically elongate scales (see Lütken, 1880, pl. 5, figs. 4, 5), are likely to be mistaken for young grammicolepids. One young acanthurid, with a most remarkable type of scales, has already been described as a grammicolepid (Smith, 1931, p. 146). These young acanthurids may be distinguished from the Grammicolepidae both by their different mouth structure and by their metallic "corselet" extending downward and forward from the pectoral base.

I experienced some difficulty at first in discovering valid characters to distinguish the two recognizable forms of Grammicolepidae. The external differences are mostly of a type unlike those that have been used in related groups, and I present them here in the form of a comparative table.

## GRAMMICOLEPIS

1. Scaly part of gular membrane not covering the blunt lower angle of the hyoid apparatus (urohyal), which is protected only by thin skin.
2. All 7 of the branchiostegal rays lacking a cover of muscle and easily seen without dissection.
3. Upper anterior angle of the pre-ventral profile (covering the anterior horn of the cleithrum), at gill slit, directly below the middle or anterior border of the pupil of the eye.
4. First anal spine shorter than eye in half grown and adult.
5. Tip of lower jaw, with mouth closed, opposite upper border of pupil.
6. Upper border of head above eye (at junction with scales of nape) sloping downward sharply behind.
7. Interopercle plainly visible beneath lower limb of preopercle; scaled.
8. Body deep when young (depth almost equal to length minus caudal peduncle in a 75 mm specimen), growing more elongate with age.
9. Anterior portion of lateral line in a high, peaked curve in half grown, flattening out into an irregular, low curve with age.
10. Ends of dorsal and anal bases almost opposite in half grown, the end of the dorsal becoming decidedly more anterior with age.
11. Anterior part of nape concave (possibly becoming straight or convex in old age).

## XENOLEPIDICHTHYS

1. Scaly part of gular membrane nearly or quite covering the blunt lower angle of the hyoid apparatus (urohyal), which is protected not only by the scaly membrane but also by a thick layer of muscle under the latter.
2. The first 3 of the 7 branchiostegal rays thickly covered by a sheet of muscle running to the lower posterior limb of the ceratohyal, and not visible without dissection of this muscle.
3. Upper anterior angle of the pre-ventral profile (covering the anterior horn of the cleithrum), at gill slit, anterior to the vertical of the front border of the orbit.
4. First anal spine nearly equal to or exceeding length of head at all ages.
5. Tip of lower jaw, with mouth closed, opposite middle or lower border of pupil.
6. Upper border of head above eye (at junction with scales of nape) sloping downward only slightly.
7. Interopercle mostly hidden under preopercle.
8. Body very deep at all ages, the depth nearly equal to or greater than the length minus caudal peduncle.
9. Anterior portion of lateral line in a high, peaked curve at all ages.
10. Ends of dorsal and anal bases practically opposite at all ages.
11. Anterior part of nape flat or convex at all ages.

## Genus GRAMMICOLEPIS Poey

*Grammicolepis* POEY, 1873, p. 403 (type by monotypy, *G. brachiusculus* Poey).

*Vesposus* JORDAN, 1921, p. 649 (type by original designation, *V. egregius* Jordan).

The generic characters are given in the table above. Only one species is known, from deep water about the West Indies, in the Caribbean, and off Hawaii.

## GRAMMICOLEPIS BRACHIUSCULUS Poey

*Grammicolepis brachiusculus* POEY, 1873, p. 403, pl. 12 (near Habana, Cuba).—SHUFELDT, 1888, p. 271, figs. 1-14 (on Poey's type specimen).—GOODE and BEAN, 1895, p. 218, pl. 61, fig. 221 (copy of Shufeldt's description and figure).—JORDAN and EVERMANN, 1896, vol. 1, p. 974 (compiled).—FOWLER, 1928, p. 96 (on Jordan's type of *Vesposus egregius*).

*Vesposus egregius* JORDAN, 1921, p. 650, fig. 5 (deep water off Hawaii).—JORDAN and JORDAN, 1922, p. 24, fig. 1 (on Jordan's type specimen).

*Grammicolepis squamilineatus* (in part) MOWBRAY, in Breder, 1927, p. 30, fig. 14 (holotype and two paratypes; deep water north of Glover Reef, British Honduras).

U.S.N.M. no. 84098, a dried and distorted specimen approximately 230 mm in standard length (to end of hypural fan); killed by lava flowing from Mauna Loa into the sea off Alike, Island of Hawaii, in November 1919, and collected by Tom Reinhardt. Holotype of *Vesposus egregius* Jordan.

U.S.N.M. no. 102129 (field no. 111), a specimen 182 mm in standard length; Johnson-Smithsonian deep-sea expedition station 23, off Punta Cerro Gordo, north coast of Puerto Rico, latitude 18°32'15" N., longitude 66°17'45" W., to latitude 18°32'00" N., longitude 66°-21'15" W.; February 4, 1933; otter trawl; 260 to 360 fathoms; S. Y. Caroline.

B. O. C. no. 517, a specimen 82 mm in standard length; deep water north of Glover Reef, off the coast of British Honduras; April 1925; S. Y. Pawnee. Holotype of *Grammicolepis squamilineatus* Mowbray.

B. O. C. no. 524, a specimen 85 mm in standard length; taken in 366 fathoms north of Glover Reef, British Honduras; April 20, 1925; S. Y. Pawnee. Paratype of *Grammicolepis squamilineatus* Mowbray.

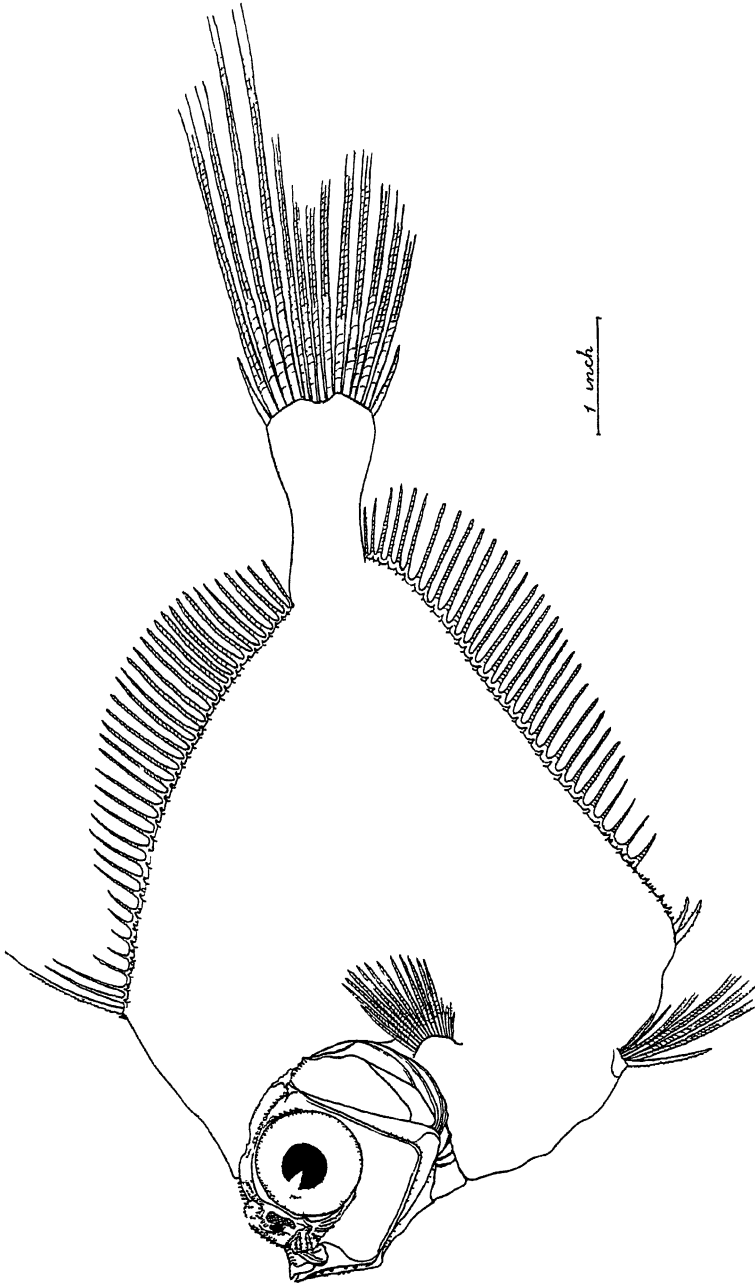
B. O. C. no. 518a, a specimen 73 mm in standard length; taken in 484 fathoms north of Glover Reef, British Honduras; April 20, 1925; S. Y. Pawnee. Paratype of *Grammicolepis squamilineatus* Mowbray.

Dorsal fin with a tiny, scarcely evident first spine; a main serrated spine; a thinner serrated spine; 3 or 4 soft, unarticulated spines; and 28 to 35 articulated rays. Anal with 2 short, serrated spines, the first longer; and 28 to 36 articulated rays. Pectorals 14 to 16. Color plain silvery, with indications of irregular dark blotches on the back.

Several important and extremely interesting changes in external anatomical features appear to take place in this species during growth.



A, *Grammicoleps inachus* Poey, half-grown example, B O C no 518a; B, *Xenolepichthys dalaesha* Gilehurst, subadult example, B O C no 518b Both specimens are paratypes of *Grammicoleps squamulneatus* Mowbray



*Grammicolepis brachiusculus* Poey, subadult example, U S N M no 102129 The scaly gular membrane has been stippled in the drawing The figure errs in showing only 32 (instead of 34) articulated anal rays

The high, acute angle of the lateral line, which is like that of *Xenolepidichthys* in the half-grown, becomes less acute in larger specimens and finally reaches an irregular low curve in the adult. Doubtless this is correlated with the considerable decrease of relative body depth with age. In most fishes the relative positions of the fin bases do not change greatly after the larval stage is passed, and characters relating to these positions are among the best and most stable of the external features used in classification. In *Grammicolepis*, however, I have been forced to the conclusion that the end of the dorsal base moves anteriorly with age, concomitant with a general pushing forward and downward of the upper part of the general bony framework of the fish. This apparently results in the head of larger specimens appearing as if it had been pushed upward (from the front) upon the axis of the body and gives the adult *Grammicolepis* a characteristic physiognomy very different from that of *Xenolepidichthys*, in which the head is much less prominent and less elevated in front.

The observation of these growth changes would not have been possible had I not been able to compare the small specimens in the Bingham Oceanographic Collection with the two larger specimens in the National Museum.

*Counts of fin rays, etc.*—These are given in the order in which the specimens are listed above. Dorsal III, III, 35; III, IV, 32; III, III, 29; III, III, 30; III, III, 28. Anal II, 36; II, 34; II, 29; II, 28; II, 28. Pectoral 15–15; 16–15; 14–14; 13–14; 14–14. Dorsal bucklers 34; 33; 29; 30; 30. Anal bucklers 35; 34; 27; 27; 27.

*Measurements in millimeters.*—These are given in the same order, the figures for the dried type of *Vesposus* being approximate only. Standard length 230; 182; 82; 85; 73. Depth 135; 115; 60; 65; 58. Head length 67; 49; 28; 29; 24. Bony orbit diameter 27; 23; 12; 14; 12. Snout length 21; 13; 8; 8; 7. Snout tip to dorsal origin 98; 67; 36; 39; 33. Dorsal base 145; 95; 42; 45; 40. Anal base 140; 104; 45; 48; 42.

*Remarks.*—Poey described and figured this species from a fresh 470 mm specimen, apparently not in very good condition, brought to the Habana market in April 1872. The type was skeletonized by Poey, and the skeleton was sent to Prof. Theodore Gill in Washington for the Smithsonian collection. A few years later Gill turned over the skeleton, which appears to have been incomplete, to Dr. R. W. Shufeldt for osteological study. Shufeldt's paper appeared in 1888, but I can find no trace of the specimen subsequent to that date. It may be that it is still in the private osteological collection of the late Dr. Shufeldt, to which I have not been able to obtain access.

In his paper on *Grammicolepis*, Shufeldt gave a complete translation of the text of Poey's paper, together with a figure of the whole fish. This figure, which was copied by Goode and Bean, was taken

largely from Poey's outline drawing but with some changes as well as the addition of the squamation.

Jordan's nominal *Vesposus* and Gilchrist's *Xenolepidichthys* were both differentiated from *Grammicolepis* by the presence of a row of strong, spiny bucklers along each side of the dorsal and anal bases, on the assumption that Poey's specimen lacked such structures. On reviewing the matter it is evident that both Jordan and Gilchrist depended entirely on Shufeldt's paper (or on Goode and Bean's partial copy of it) and that Shufeldt misinterpreted, and erroneously translated, one important sentence in Poey's account.

In the course of his description of the scales, Poey says, "La primera, tanto arriba como abajo, es más corta y lleva en la cabeza dos puntas endurecidas que acompañan la base de los radios." In connection with the context of the paragraph as a whole, I translate this as follows: "The first [scale], both above [=dorsally] and below [=ventrally], is shorter [than those toward the middle of the body] and carries at the head [end] two strong points which accompany the base of the rays." These strong points, or spines, and perhaps the fins themselves, were evidently not present on the skeleton when Shufeldt received it, and, being unable to understand what Poey meant, he translated the sentence as, "The leading scales on the body, above as well as below, are shorter and when carried on to the head, are doubly as firm as those found at the base of the fin rays." Knowing that all other grammicolepids have these spines, one can easily see what Poey was attempting to describe.

Moreover, Poey's outline drawing, which did not show the rays of the soft dorsal and anal, clearly figures the row of spines along the base of both dorsal and anal. Shufeldt took these spines for indications of the bases of the fin rays, and they do not appear in his figure, in which the rays are drawn in.

The only other point that might cause confusion is Poey's statement that *two* points are present. From my description above it is clear that at least the anterior spine-bearing bucklers at the fin bases show one or more subsidiary spines.

It is possible that the differences in meristic characters between the type of *Vesposus* and the smaller specimens from the Caribbean may have some significance. With my present material I am unable to do more than call attention to the fact.

The figure of the type of *Vesposus egregius* given by Jordan and by Jordan and Jordan, drawn from the dried and twisted type, is incorrect in a number of details and entirely lacks the very characteristic physiognomy of *Grammicolepis*, which is apparent even in the dry specimen.

Poey's large type appears to represent the fully adult form of the species. No other examples as large as his have been found.

Genus **XENOLEPIDICHTHYS** Gilchrist

*Xenolepidichthys* GILCHRIST, 1922, p. 73 (type by monotypy, *X. dalgleishi* Gilchrist).

*Grammicolepis* (in part) MOWBRAY, in Breder, 1927, p. 29.

The generic characters are given in the table above. Only one species is known, from deep water in the Caribbean Sea, off South Africa, and about the Philippines.

**XENOLEPIDICHTHYS DALGLEISHI** Gilchrist

*Xenolepidichthys dalgleishi* GILCHRIST, 1922, p. 73, pl. 12, fig. 1 (*Pickle* stations 104, lat. 29°57'05" S., long. 31°14'30" E; 111, lat. 29°43'30" S., long. 31°22'30" E; 141, lat. 29°48'55" S., long. 31°22'30" E.).—BARNARD, 1925, p. 371, pl. 16, fig. 1 (off Natal coast; Algoa Bay; off Saldanha Bay); VON BONDE, 1928, p. 26 (*Pickle* station 779, about lat. 29°48' S., long. 31°25' E.); 1933, pp. 59, 60, 61 (*Africana* stations 238A, lat. 29°48'55" S., long. 31°19'40" E; 239A, lat. 29°50'06" S., long. 31°21'00" E; 240A, lat. 29°53'40" S., long. 31°19'12" E.).—J. L. B. SMITH, 1935, p. 184, pl. 18, fig. A (Great Fish Point).—FOWLER, 1935, p. 373 (Durban).

*Grammicolepis squamilineatus* (in part) MOWBRAY, in Breder, 1927, p. 30 (one paratype; deep water north of Glover Reef, British Honduras).

U.S.N.M. no. 98830 (field parchment tag 1743), a specimen 87 mm in standard length; station D. 5112, off Sombrero Island, southern Luzon, latitude 13°48'22" N., longitude 120°47'25" E.; January 17, 1908; 12-foot Tanner beamtrawl; 177 fathoms; U. S. S. *Albatross*.

U.S.N.M. no. 98831 (field parchment tag 1742), a specimen 71 mm in standard length; same data as no. 98830. Figured example.

U.S.N.M. no. 98832 (field parchment tag 1744), a specimen 90 mm in standard length; same data as no. 98830.

B.O.C. no. 518b, a specimen 82 mm in standard length; taken in 484 fathoms north of Glover Reef, British Honduras; April 20, 1925; S. Y. *Pawnee*. Paratype of *Grammicolepis squamilineatus* Mowbray.

Dorsal fin with a tiny, scarcely evident first spine; a main serrated spine, which is long and provided with a filamentous tip in the young; a thinner serrated spine; three soft, unarticulated spines; and 28 or 29 articulated rays. Anal with a long, serrated first spine, nearly as long as, or longer than the head, its tip filamentous in the young; a second shorter serrated spine; and 27 to 29 articulated soft rays. Pectorals with 14 rays. Color silvery, the younger specimens with round dark spots, placed irregularly.

This species differs decidedly from *Grammicolepis* in the lesser extent of the changes in proportions and other external features during growth. The younger specimens have filamentous tips to the second dorsal and first anal spines, which are lost with growth, and the relative length of the second dorsal spine decreases. The body is deeper in the young than in the adult, but even the latter retains a very deep form. The high, pointed arch of the lateral line and the



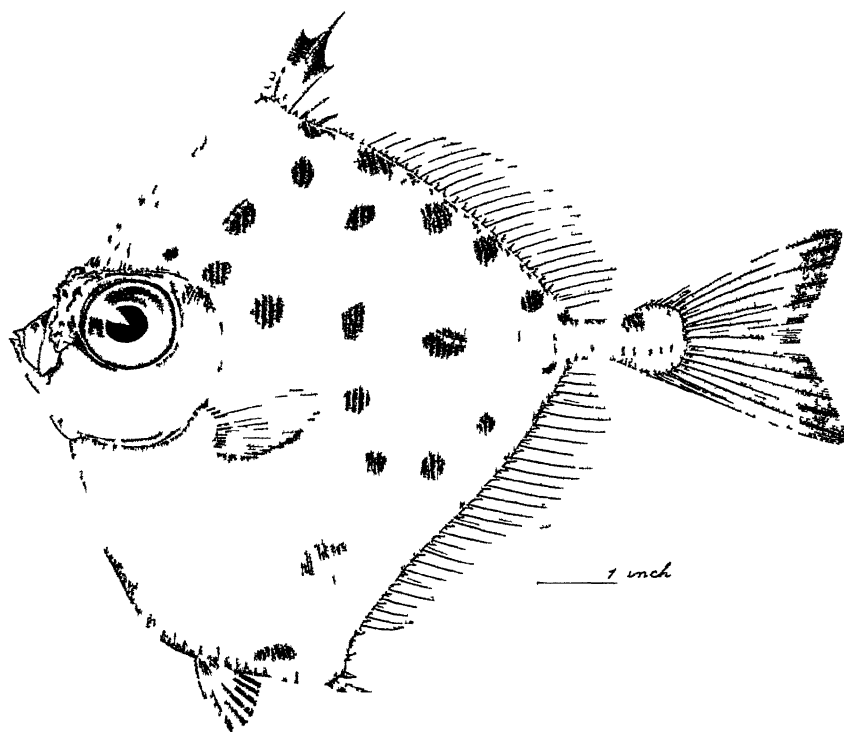
relative position of the ends of the dorsal and anal fins remain constant through life.

*Counts of fin rays, etc.*—These are given in the order in which the specimens are listed above. Dorsal III, III, 28; III, III, 29; III, III, 29; III, III, 28. Anal II, 27; II, 28; II, 29; II, 28. Pectoral 14-14; 14-14; 14-14; 14-14. Dorsal bucklers 29; 31; 30; 30. Anal bucklers 27; 27; 27; 27.

*Measurements in millimeters.*—These are given in the same order. Standard length 87; 71; 90; 82. Depth 78; 68; 80; 68. Head length 26; 22; 29; 26. Bony orbit diameter 13; 11; 14; 13. Snout length 8; 6; 9; 8. Snout tip to dorsal origin 47; 38; 48; 43. Dorsal base 51; 43; 52; 44. Anal base 54; 46; 56; 49.

*Remarks.*—This peculiar, deep-bodied fish has been known heretofore only from off South Africa, whence it was described by Gilchrist in 1922. The three Philippine examples recorded here were obtained by the *Albatross* many years before *Xenolepidichthys* was discovered in South Africa. The figure of one of these specimens, here reproduced as plate 7, was made by K. Ito on board the *Albatross* during the cruise on which the fishes were captured.

There is no doubt whatsoever of the identity of one of Mowbray's paratypes of *Grammicolepis squamilineatus* with this species. The fact that this specimen was not distinguished by Mowbray from his other examples, which are plainly *Grammicolepis*, is evidence of the remarkable similarity of the young of the latter genus to *Xenolepidichthys*.



*Xenolepidichthys dalgleishi* Gilchrist, subadult example, U S N M no 98831  
 The figure errs in showing 28 (instead of 29) articulated rays, and the upper border of the head, above the eye, is too strictly horizontal. Drawn by K Ito



# LITERATURE CITED

BARNARD, KEPPEL H.

1925. A monograph of the marine fishes of South Africa (pt. 1). Ann. South African Mus., vol. 21, pp. 1-418, 27 pls.

BONDE, CECIL VON.

1928. List of fishes, etc., procured by the S. S. *Pickle* during the period July 1, 1925, to May 25, 1927. Union of South Africa, Fisher. Mar. Biol. Surv., Rep. no. 5 (1925-1927), pp. 16-85.  
1933. Cape area survey: January-May, 1932—Table Bay—Saldanha Bay. List of fishes, etc., procured. Union of South Africa, Fisher. Mar. Biol. Surv., Rep. no. 10 (1932), pp. 32-84.

BOULENGER, GEORGE ALBERT.

1902. Notes on the classification of teleostean fishes. IV. On the systematic position of the Pleuronectidae. Ann. Mag. Nat. Hist., ser. 7, vol. 10, pp. 295-304.

BREDER, CHARLES MARCUS, Jr.

1927. Scientific results of the first oceanographic expedition of the *Pawnee*, 1925. Fishes. Bull. Bingham Oceanogr. Coll., vol. 1, art. 1, pp. 1-80, 36 figs.

FOWLER, HENRY WEED.

1928. The fishes of Oceania. Mem. Bernice P. Bishop Mus., vol. 10, 540 pp., 82 figs., 49 pls.  
1935. South African fishes received from Mr. H. W. Bell-Marley in 1935. Proc. Acad. Nat. Sci. Philadelphia, vol. 87, pp. 361-408, 39 figs.

GILCHRIST, JOHN DOW FISHER.

1922. Deep-sea fishes procured by the S. S. *Pickle* (pt. 1). Union of South Africa, Fisher. Mar. Biol. Surv., Rep. no. 2 (1921), pt. 3 (special reports), pp. 41-79, 6 pls.

GILL, THEODORE NICHOLAS.

1893. Families and subfamilies of fishes. Mem. Nat. Acad. Sci., vol. 6, pp. 127-138.

GOODE, GEORGE BROWN, and BEAN, TARLETON HOFFMAN.

1895. Oceanic ichthyology, a treatise on the deep-sea and pelagic fishes of the world, based chiefly on the collections made by the steamers *Blake*, *Albatross*, and *Fish Hawk* in the northwestern Atlantic. U. S. Nat. Mus. Spec. Bull. 2, xxxvi+553 pp., 123 pls.

JORDAN, DAVID STARR.

1905. A guide to the study of fishes, 2 vols.  
1921. Description of deep-sea fishes from the coast of Hawaii, killed by a lava flow from Mauna Loa. Proc. U. S. Nat. Mus., vol. 59, pp. 643-656, 8 figs.  
1923. A classification of fishes, including families and genera as far as known. Stanford Univ. Publ., Univ. Ser., Biol. Sci., vol. 3, no. 2, pp. 79-243.

JORDAN, DAVID STARR, and EVERMANN, BARTON WARREN.

1896. The fishes of North and Middle America. U. S. Nat. Mus. Bull. 47, pt. 1, ix+1,240 pp.

JORDAN, DAVID STARR, and JORDAN, ERIC KNIGHT.

1922. A list of the fishes of Hawaii, with notes and descriptions of new species. Mem. Carnegie Mus., vol. 10, no. 1, pp. 1-92, 4 pls.

## KINGSLEY, JOHN STERLING.

1885. The standard natural history, vol. 3 (Vertebrata), vi+478 pp., 270 figs., 16 pls.

## LÜTKEN, CHRISTIAN FREDERIK.

1880. *Spolia Atlantica*. Bidrag til kundskab om formforandringer hos fiske under deres væxt udvikling, særligt hos nogle af Atlanterhavets Højsøfiske. Danske Vid. Selsk. Skrift., ser. 5 (nat.-math.), vol. 12, pp. 413-613, 25 figs., 5 pls.

## POEY Y ALOY, FELIPE.

1873. *Grammicolepis brachiusculus*, tipo de una nueva familia en la clase de los peces. Anal. Soc. Española Hist. Nat., vol. 2, pp. 403-406, 1 pl.

## REGAN, CHARLES TATE.

1910. The anatomy and classification of the teleostean fishes of the order Zeomorphi. Ann. Mag. Nat. Hist., ser. 8, vol. 6, pp. 481-484.

## SHUFELDT, ROBERT WILSON.

1888. Further studies on *Grammicolepis brachiusculus* Poey. Journ. Morph., vol. 2, no. 2, pp. 271-296, 14 figs.

## SMITH, J. L. B.

1931. New and little-known fish from the south and east coasts of Africa. Rec. Albany Mus., vol. 4, pt. 1, pp. 145-160, 1 pl.  
1935. New and little-known fishes from South Africa. Rec. Albany Mus., vol. 4, pt. 2, pp. 169-235, 6 pls.

## WEBER, MAX.

1913. Die Fische der *Siboga*-Expedition. *Siboga*-Expeditie, vol. 57, xli+710 pp., 12 pls.



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## NEW NORTH AMERICAN SPECIES OF EARTHWORMS OF THE FAMILY MEGASCOLECIDAE

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AMONG the more interesting specimens of Oligochaeta in the collections of the writer are some that were taken in Oregon and that belong to new species of the genera *Megascolides* McCoy and *Plutellus* E. Perrier. Only one North American species of *Megascolides* and only a few of *Plutellus*, chiefly from California, have been described.

### SOURCE OF MATERIAL

A brief description of *Megascolides americanus* Smith was published by the writer in 1897, but it was necessarily incomplete because the only available material for study consisted of four specimens that had been collected at a time of sexual inactivity when the reproductive organs were not well developed. The specimens were received from R. W. Doane, of the Washington State Agricultural College at Pullman, Wash. No other material has since been available for study until 1931, when five specimens were received from Roy Hansberry, of the same institution. They were collected by Dr. Arthur Svihla on March 21, 1931, again at a time when the reproductive organs were not at the height of activity. Later in the same year a specimen of the same species was received for identification that had been collected at Moscow, Idaho, a few miles east of Pullman. A study of this material recently received, together with a further study of the original specimens, has brought to light additional data.

Descriptions of the new species of *Megascolides* in this paper are based on material received from different parts of Oregon. F. M. McElfresh, of Salem, Oreg., in the autumn of 1899 sent a single specimen, collected in the Cascade Range, that belongs to an undescribed species of this genus. No data concerning the exact location and date of collection are available. In January 1903, Mr. McElfresh sent a specimen that had been collected at or near Salem, and it was found to belong to another species of *Megascolides*. These two specimens and two others belonging to a new subspecies of *Plutellus* were carefully studied as the basis for a thesis in partial fulfillment of the requirements for the degree of master of arts in zoology in the Graduate School of the University of Illinois in 1917 by Lola E. Swift (Faust) under the supervision of the writer. The results of this study have not had formal publication and have been utilized in part herein. In February and March 1931, F. E. Garlough, director of the Control Methods Research Laboratory of the United States Biological Survey at Denver, Colo., sent material that included collections made in Oregon at Netarts, near the Pacific coast, and at Multnomah in the northern interior part of the State. These collections include specimens of new species of *Megascolides* and *Plutellus*.

The material from these various sources has supplied data for the description of the following new species and subspecies: *Megascolides cascadiensis*, *M. macelfreshi*, *M. michaelsoni*, *M. eiseni*, *Plutellus garloughi*, *P. oregonensis*, *P. o. swiftae*.

Two of the new species of *Megascolides* are based on but a single specimen of each, and these were collected at a time when the reproductive organs were not fully developed. When these specimens were prepared for examination, lack of experience in studying such animals resulted in a lack of the best mode of their preparation for such study and hence in less adequate data than would be desirable. The differences between these individuals and those of other kinds studied are sufficiently great to convince the writer that they must belong to distinct species, and they have been so treated, in spite of the desirability of having a larger number of specimens and more adequate data. It is hoped that more extensive collections from various parts of Oregon and adjacent States may be made and studied, for still other new species of Megascolecidae probably may be found in that region.

#### TERMINOLOGY

Before presenting details of anatomy in the descriptions, it seems desirable to refer briefly to the terminology used. There is much diversity in the terms used by different writers in describing the

various organs in Oligochaeta and not infrequently in those used at different times by the same writer. In describing the reproductive organs the writer prefers the terms spermaries and ovaries, respectively, for the male and female gonads and also the terms sperm ducts and oviducts for the ducts through which the germ cells pass on their way outward. The terms sperm sacs and ovisacs are used for the chambers that are formed by evagination of septa of the gonad somites and that provide space in which the germ cells may pass through a part of their development. The term spermathecae is used for the chambers having openings on the outer surface of the body wall and that store the sperm cells received from some other individual. The term prostates is used for certain organs associated with the male reproductive organs of some kinds of earthworms, including those described in this paper. The terms spermathecal ducts and prostate ducts are applied to the ducts through which the cavities of the spermathecae and prostates, respectively, are in communication with the exterior.

The openings of the various ducts at the body surface are termed pores, and there are spermiducal pores, oviducal pores, spermathecal pores, and prostatic pores. Because of the fact that in some kinds of earthworms, including those described in this paper, the sperm ducts open into the cavities of the prostate glands or ducts instead of at the body surface, thereby making but one pair of surface pores for these two or three pairs of organs, there is chance for confusion if either of the terms spermiducal pores or prostatic pores is used in the description of such species. The term male pores seems to the writer to be preferable and is used in the descriptions herein for openings that are outlets for both prostate ducts and sperm ducts that have united before reaching the surface.

In some groups of earthworms, including many of the Megascolecidae, there is present a longitudinal blood vessel in close relation with the median dorsal surface of the alimentary tract of a few of the somites of the posterior half of the esophagus and lying between it and the dorsal vessel. The term suprainestinal is commonly used for this vessel, even though it is connected with the esophagus instead of the intestine. Another term sometimes used is supra-esophageal, which seems preferable and is used in the descriptions herein.

The term "hearts" is often applied to certain contractile commissural vessels connecting the dorsal and ventral vessels. In some kinds of earthworms some of these hearts have their dorsal connection with only the dorsal vessel and are called dorsal hearts, while some of the posterior ones may have connections with both the dorsal and supra-esophageal vessels and are termed dorso-esophageal hearts. In the species of *Megascolides* here described the supra-esophageal vessel is not so definitely separated from the dorsal part of the vascu-



lar plexus of the esophagus as it is in many species, and the major dorsal openings of the more posterior hearts are more directly connected with the plexus, but the term dorso-esophageal hearts seems just as appropriate and is used.

Calciferous gland is a term applied to a kind of glandular development found in the wall of certain parts of the esophagus of some kinds of earthworms, including the Lumbricidae, *Diplocardia*, and some others. Similar organs are found in the species of *Megascolides* and *Plutellus* here described. In such worms there may be one or more pairs of lateral enlargements within which the epithelial lining of the lumen has numerous diverticula, folds, or even lamellae with an abundant supply of branches of the circulatory system. In some cases, especially among the Lumbricidae, small particles of calcium carbonate appear in abundance in such glands. In the Lumbricidae these glands are usually located in somites 10-14. In *Diplocardia* they are found in somites 14-15, and in the different species of that genus there is a notable diversity in the extent of their development. In some species the folds are not very high or very numerous, while in certain other species they are more numerous and crowded and attain a complexity similar to that found in the Lumbricidae. A similar variability in complexity is found in species of *Megascolides* and *Plutellus* described in this paper. In these species the calciferous glands are located in somites 9, 10, or 11 to 14, 15, or 16.

Nephridia are lacking in a very few somites at the anterior and posterior ends of worms belonging to *Megascolides*, as they are in other kinds of North American earthworms, but instead of the other somites having but one pair to each somite there are several times as many nephridia to each somite in the species of *Megascolides*. The nephridia in the anterior part of the body are all very small and are known as micronephridia. In the posterior region each somite with nephridia has several micronephridia and also a single pair of larger ones termed meganephridia.

#### Genus MEGASCOLIDES McCoy

*Megascolides* McCoy, Prodromus of the zoology of Victoria, vol. 1, decade 1, p. 21, 1878.

The discovery of a species of *Megascolides* in North America in 1896 was of considerable interest because of the fact that other species of the genus had been found only in the region of Australia, southeastern Asia, and neighboring areas. The discovery of several additional species in a limited region in North America, all of them different from the known Old World species, naturally leads to the assumption that the first appearance of representatives of the genus in North America may have been at a time sufficiently long past to have allowed the differentiation of new species since.

Important characters of the genus *Megascolides* as given by Stephenson (1930, p. 835) are: "Setae eight per segment. Spermathecal pores one to five pairs, the last in furrow 7/8 or 8/9 or on segment ix. One gizzard in the region of segments v and vi. Micronephridial at least in the anterior part of the body, often throughout. Prostates tubular, with simple unbranched canal." Equally important are certain other characters found also in some other genera of the subfamily Megascolecinae. Each of the ducts of the one pair of prostate glands is united with the sperm duct or ducts of the same side of the worm, and they open in common on somite 18.

**MEGASCOLIDES AMERICANUS Smith**

*Megascolides americanus* SMITH, Amer. Nat., vol. 31, p. 203, 1897.

*Distinguishing characters.*—Length of fairly well extended specimens, 180–190 mm. Diameter, 6–7 mm. Number of somites in eight specimens averaged 235. Setal distances in anterior part, approximately  $aa:ab:bc:cd=10:2:8:4$ ; and posterior to the clitellum  $aa:ab:bc:cd=12:3:7:4$ ;  $dd$  in the anterior part is about two-thirds of the circumference and posteriorly is but little more than one-half of the circumference. Penial setae on 18, very closely paired, long, slender, curved in sagittal plane, with distal one-third projecting posteriad from openings, and finely sculptured near tips. The clitellum includes 13–22 and part of 23; incomplete ventrally; reddish tan color. Circular, median, ventral papillae on 14/15, 15/16, and 16/17; paired ventral papillae on 19/20, 20/21, and in some specimens on 21/22. A pair of prominent transversely elongate papillae on 18, bearing penial setae and male pores. Spermathecal pores on 7/8 and 8/9.

Septa 7/8–11/12 are strongly thickened, 6/7 and 12/13 less thickened. Calciferous gland in 11–15 and less definitely developed than in some species. The two sperm ducts of either side unite in 16, and the common duct thus formed opens into the proximal part of the prostate duct of the same side. Spermathecae paired in 8 and 9.

*External characters.*—Presumably owing to differences in treatment when they were preserved, the four specimens collected in 1896 at Pullman, Wash., were less contracted than were the five specimens collected there in 1931. In some specimens in each collection the diameter in the region of 18 is not much more than one-half as great as that near 8 and 30, where the diameter is at a maximum. The average length of specimens in the earlier collection is 180–190 mm and the maximum diameters 6–7 mm; while the length of those in the later collection is 150–160 mm and the maximum diameters 8–10 mm. One specimen in the earlier collection was ap-

parently incomplete and has but 190 somites; the average number in the other eight specimens of the two collections is 235 somites, with extremes of 218 and 246.

The setae are relatively small and inconspicuous. Anterior to the clitellum only a few of the setae are visible superficially, and one-half or more of them are lacking, although the setae sacs are present in normal number and arrangement. A similar condition exists in some other species described in this paper. In some specimens penial setae are present. Those in the paratype are about 1.5 mm in length, 0.027 mm in diameter throughout most of the length, curved in a nearly sagittal plane with the convex side of the curve anteriad, and with slightly more than one-third of the length protruding from the body and directed posteriad. The sculpture is very fine and noticeable on only the distal portion. The prostomium is prolobic. The first five or six somites are biannulate or partially triannulate, and the others are definitely triannulate. The clitellum includes somites 13-22 and part of 23 and is incomplete ventrally. Its color is reddish tan and is more obvious in specimens having best developed reproductive organs. Elsewhere the preserved specimens lack pigmentation. Circular, median, ventral papillae are present on most specimens on 14/15, 15/16, and 16/17, and there are paired ventral papillae on 19/20 and 20/21. One specimen had an additional pair on 21/22, and another specimen had a papilla on one side of 21/22. A pair of prominent transversely elongate papillae on 18 bear the male pores and closely associated penial setae.

Dorsal pores are present in somites posterior to the clitellum. Nephridiopores are very small and several on each side of most somites. The male pores on 18 are slightly laterad of the penial setae and very close to them. The pair of oviducal pores on 14 are anterior to setae *a* and slightly mesad of them. Spermathecal pores are paired at the anterior margins of 8 and 9 and between setal lines *a* and *b*.

*Internal characters.*—The septa 7/8-11/12 are strongly thickened, those of 6/7 and 12/13 are somewhat less thickened, and 5/6 and those posterior to 13 are of normal thickness. The pharynx has a thick dorsal wall, and a powerful gizzard is present in 5. The inner lining of the esophageal wall of 6-10 has a few rather prominent folds, which are mostly longitudinal. In 11-15 the esophagus is somewhat dilated between the constrictions caused by the septa. The enlargements in 12-14 are most pronounced, the maximum horizontal diameter being about one-third of that of the body. The inner surface is very irregular, owing to the presence of numerous elongate diverticula of which many extend nearly to the middle of the lumen and some are more or less flattened. These diverticula are very variable in length, width, and direction, and some of them are

branched. The blood plexus of the middle layer of the esophageal wall has branches extending into many of the diverticula. It seems probable that the function of this part of the alimentary tract is similar to that of the organs known as calciferous glands in some kinds of earthworms, and, since in some closely related species described in this paper this part of the esophagus becomes more highly modified into a definite calciferous gland, it seems advisable to apply the same term to this part of the esophagus in the present species. The intestine begins in 19 but does not attain maximum enlargement anterior to 21. A typhlosole is present but is not large.

The study of the circulatory system has added to the facts given in the preliminary report (Smith, 1897) but does not provide material for a complete description. A dorsal vessel and ventral vessel are present as in other earthworms. No lateral neural or subneural vessels were found, a condition commonly reported in *Megascolecidae*. Because of incompleteness in the series of sections available, the anterior and posterior extremities of the supra-esophageal vessel were not located. Enlargements of the vessel and communications with the plexus of the esophagus are present in 9-14. The parts of the vessel that connect these enlargements and pass through the septa are inconspicuous. Paired dorso-esophageal hearts are present in 10-13, where their chief dorsal communication is with the supra-esophageal vessel. In each of somites 7-9 is a pair of smaller dorsal hearts. The micronephridia in the specimens examined seemed to be present in somites beginning with the second one, and the number is somewhat variable, but there are approximately seven on each side of the somites. There is also a pair of meganephridia in each of the somites in the posterior part of the worm.

The reproductive organs are similar to those commonly found in the genus. Spermaries and spermiducal funnels are paired in each of somites 10 and 11 and the sperm ducts of either side unite in 16, and the common duct thus formed opens into the proximal end of the prostate duct of the same side. Paired sperm sacs in 11 and 12 open through septa 10/11 and 11/12 into the cavities of 10 and 11, respectively. The openings are near the lateroventral esophageal wall. One pair of tubular prostate glands is present in 18. The glandular part of each is long, tubular, and contorted and occupies considerable space. Each prostate duct has a length about equal to a half of the diameter of the worm and is an outlet not only for gland secretions but also for sperm cells. Ovaries and oviducal funnels are paired in 13 and oviducts in 14. There is a pair of spermathecae in each of somites 8 and 9. In the sexually inactive specimens available for study the spermathecal ducts are very short, and each has on the anterior lateral wall a diverticulum with thick irregular walls.

The ampulla of each spermatheca is of nearly spherical form and has relatively thick walls with irregular folds present in the interior surface. These folds are more prominent on the part of the wall nearest the median longitudinal axis of the worm.

MEGASCOLIDES CASCADENSIS, new species

*Distinguishing characters.*—Length of preserved specimen, 185 mm. Diameter, 5–7 mm. Somites, about 265. Setal distances, approximately  $aa:ab:bc:cd=14:3:8:6$ ;  $dd$  in anterior region about two-thirds of circumference and in posterior region about one-half of circumference. Penial setae, two pairs on 18, more than 1.5 mm long; 0.035–0.04 mm in diameter; each has a rather abrupt curve near the outer end and very minute sculpturing; the remaining part is nearly straight. The clitellum includes 13–20 and is incomplete ventrally. Paired ventral papillae on 15/16, 16/17, 19/20, and 20/21. Spermathecal pores on 7/8 and 8/9. Septa 6/7–11/12 most strongly thickened. Calciferous gland with irregular diverticula extending into the lumen in 10–15, reaching two-thirds of the distance to the middle of the lumen in thirteenth somite and less in others. Sperm ducts enter separately into prostate gland at the beginning of the prostate duct. Spermathecae paired in 8 and 9.

*Material.*—The only material available is an alcoholic specimen, the holotype (U.S.N.M. no. 20243), received from F. M. McElfresh of Salem, Oreg., in the autumn of 1899 with the statement that it was collected in the Cascade Range in Oregon and with no other data. Soon after the specimen was received transverse sections were made of a piece including the lateral half of somites from the middle of 14 to the middle of 19 as indicated by external characters, but the internal parts were displaced somewhat posteriad, and the sections included the alimentary tract and parts of the circulatory system of the posterior part of the thirteenth somite. Transverse and sagittal sections were also made of pieces near the posterior end. More recently the anterior part of the specimen was split in the median sagittal plane. A study of these parts and sections, and of the external characters of the remainder of the specimen, has supplied data for the following description, which, though far from complete, seems sufficient to warrant the recognition of a species distinct from those previously described.

*External characters.*—The length is 185 mm, and the maximum diameter anterior to the clitellum is 7 mm and posterior to the clitellum 5–6 mm. In the middle of the clitellar region the diameter is somewhat less than in adjacent parts. The number of somites is about 265. Somites posterior to 5 are triannulate. The setae are small and inconspicuous, with a length less than the thickness of the body wall, and some are lacking. The setal distances both

anteriorly and posteriorly are approximately  $aa:ab:bc:cd=14:3:8:6$ ;  $dd$  anteriorly is nearly two-thirds of the circumference and posteriorly only about one-half of it. The penial setae are very closely approximated on each side of 18 and also very close to the male pores, which are slightly laterad of  $b$ . The sectioned penial setae were in fragments, but the length is evidently more than 1.5 mm and the diameter 0.035–0.04 mm. There is an abrupt curve near the distal end, but elsewhere the setae were apparently nearly straight. The terminal parts are minutely sculptured. The clitellum is incomplete ventrally and includes 13–20. Paired ventral papillae are present on 15/16, 16/17, 19/20, and 20/21.

Dorsal pores are present posterior to the clitellum. Nephridiopores are very inconspicuous and situated near the anterior margins of the somites. The male pores are paired on 18 slightly laterad of seta line  $b$ , and the protruding penial setae are in paired depressions of the ventral surface. Oviducal pores are paired on 14. Spermathecal pores paired on 7/8 and 8/9 in seta line  $b$ .

*Internal characters.*—Septa 6/7–11/12 are most thickened. A lack of sections of the anterior dozen somites accounts for a lack of details concerning some of the organs of those somites. A thick-walled pharynx is followed by a powerful gizzard in 5. The sectioned part of the esophagus posterior to the middle of 13 has the type of structure termed calciferous gland but is of the simpler type such as is found in *M. americanus*. The lining layer of the lumen forms numerous irregularly arranged elongate diverticula, which are of variable length, and many extend nearly two-thirds of the way to the middle of the lumen. They receive an abundant blood supply from the vascular plexus in the esophageal wall. An examination of the alimentary tract in the unsectioned region reveals a gradual increase in diameter and in the number and length of the diverticula in 10–13. The differentiation of this part of the esophagus as a calciferous gland is even less than that found in *M. americanus*. In 16 and 17 the lining layer forms longitudinal folds not extending far into the lumen. The folds become fewer in number in the following somites, and then the enlarged intestinal tract begins at about the twentieth somite. A definite typhlosole is present.

The circulatory system has not been thoroughly studied but seems similar in essentials to that in the other species here described. Three pairs of smaller hearts are present in 7–9, and four pairs of larger hearts are present in 10–13. The pair in 13 are the only ones of which sections were made, and they are of the dorso-esophageal type, opening into the ventral vessel below, and dorsally each of them has a small branch that opens into the dorsal vessel and a larger one opening directly into the esophageal vascular plexus. It seems probable

that the hearts of 10-12 have similar relations. In the sectioned part a distinct supra-esophageal vessel is present for only very short distances where the esophagus passes through the septa 13/14 and 14/15. The status of the supra-esophageal vessel anterior to 13 has not yet been determined. It seems to end posteriorly in somite 15. The nephridial system is of the micronephric type, with six or seven micronephridia on each side of anterior somites and about four micronephridia and one meganephridium on each side of posterior somites.

A pair of spermaries and of spermiducal funnels is present in each of somites 10 and 11, and the two sperm ducts of either side extend posteriorly closely parallel and between the epithelium and muscle layer of the body wall until they reach 18, where they leave the body wall and enter the prostate gland at the beginning of the prostate duct. They do not unite before reaching the lumen. A pair of ovaries and of oviducal funnels is present in 13. A pair of spermathecae is present in each of somites 8 and 9, and the duct of each is short; no diverticula were noticed.

MEGASCOLIDES MACELFRESHI, new species

*Distinguishing characters.*—Length of preserved specimen, 155 mm. Diameter, 7-8 mm. Somites, 282. Setal distances, approximately  $aa:ab:bc:cd=6:2:3:3$ ;  $d\bar{d}$  is slightly more than one-half of the circumference. Penial setae nearly straight, with distal end rather abruptly curved and tapering; length probably not over 1 mm and diameter less than 0.04 mm. Clitellum 13-21 and incomplete ventrally. Paired ventral papillae on 14/15-16/17 and 19/20. Oviducal pores on transverse elevation on 14 and nearer to seta line  $a$  than to median line. Spermathecal pores on 7/8 and 8/9. Calciferous gland in 10-15 with numerous diverticula but of simpler type. Sperm ducts in close contact when they enter the prostate gland very near its union with the prostate duct and then seemingly unite before opening into the lumen of the gland. Spermathecae paired in 8 and 9.

*Material.*—The only specimen available for study is the holotype (U.S.N.M. no. 20244), which was received in living condition from F. M. McElfresh, of Salem, Oreg., in January 1903. The anterior 22 somites were split in the median sagittal plane, and transverse sections were made of the part of one-half that included the posterior part of 16 to the posterior part of 22. Transverse and sagittal sections were made from parts near the posterior end to provide material for a study of the nephridia. The sections were prepared soon after the specimen was received and before the writer realized the desirability of a study of the calciferous gland region and of certain parts of the circulatory and reproductive systems.

*External characters.*—The color of the living specimen was a pale flesh tint, more pronounced on the 10 anterior somites. The clitellum was fleshy orange in color. The length when fully relaxed was about 300 mm, but the preserved specimen has a length of 155 mm. Diameter, 7–8 mm. Number of somites, 282. Prostomium small and apparently prolobic. The setae are relatively small and widely spaced; approximately  $aa:ab:bc:cd=6:2:3:3$ . In the posterior region  $dd$  is but little more than one-half of the circumference, while in the anterior region it is nearer two-thirds of the circumference. The length of the setae is variable and commonly 0.4–0.5 mm, with a maximum diameter of about 0.028 mm. The penial seta of the sectioned part is seta  $b$  of 18, and seta  $a$  is lacking. There is a partially developed reserve seta in each of the setal sacs  $a$  and  $b$ . The length of the fully developed penial setae is probably not more than 1 mm. The maximum diameter is less than 0.04 mm. They are nearly straight throughout the greater part of the length, but the distal part of the protruded portion is rather abruptly curved and tapers. The distal end has very minute sculpturing, difficult to recognize. The male pores and the setal apertures of  $a$  and  $b$  are very close together.

The clitellum is incomplete ventrally and includes 13–21. The thickened glandular wall terminates ventrally between seta lines  $b$  and  $c$ . Paired ventral papillae are present on 14/15–16/17 and 19/20 in line with the ventral pairs of setae, and small asymmetrically placed ones are present on 20/21 and 21/22. Dorsal pores are present, posterior to the clitellum. Nephridiopores are very inconspicuous and situated near the anterior margins of the somites. The male pores are paired on 18 slightly laterad of seta line  $b$ . Oviducal pores are paired on the anterior part of 14 nearer to seta line  $a$  than to the median ventral line and are borne on an elongate transverse elevation. Spermathecal pores are paired on 7/8 and 8/9 in seta line  $b$ .

*Internal characters.*—Septa 7/8–10/11 are strongly thickened and 6/7 and 11/12 less strongly thickened. The alimentary tract includes an eversible buccal sac followed by a pharynx with a thick muscular dorsal wall and a gizzard in 5, which is enlarged and forces the septa of 5/6 and 6/7 posteriad. The calciferous gland region in 10–15 is of the simpler type similar to that found in *M. americanus*. There is a gradual increase in diameter and in the number and length of the diverticula from 10 to 13, with maximum development in 14 and 15, where some of them extend nearly two-thirds of the way to the middle of the lumen. In 16 and 17 the lining layer of the esophagus forms longitudinal folds not extending far into the lumen. The enlarged intestinal tract begins at about the 20th somite and has a definite typhlosole. The circulatory system has not been carefully studied, but there are smaller hearts paired



in 7-9, which presumably are dorsal hearts, and larger ones paired in 10-13, which probably are dorso-esophageal hearts. The nephridial system is similar to that of other species of *Megascolides* and is micronephric in the anterior region, and in the posterior region, in addition to five or six micronephridia on each side of each of most somites, there is a pair of meganephridia in each somite.

A pair of spermaries and of spermiducal funnels is present in each of somites 10 and 11, and the two sperm ducts of either side are closely parallel and extend posteriad between the muscular layer and epithelium to 18, where they become separated from the body wall, and to the prostate gland, which they enter near its union with the proximal end of the prostate duct. The two sperm ducts seem to unite just before reaching the lumen of the gland. There is a pair of sperm sacs in each of somites 11 and 12. A pair of prostate glands is present in 18 that are long and contorted and occupy much space, displacing the septa of adjacent somites. A pair of ovaries and of oviducal funnels is present in 13. A pair of spermathecae is present in each of somites 8 and 9 which have very short spermathecal ducts and seem to lack visible diverticula.

**MEGASCOLIDES MICHAELSENI, new species**

*Distinguishing characters.*—Length of strongly contracted specimens, 95-110 mm. Diameter, 4.5-8 mm. Number of somites in eight specimens averaged 202. Setal distances in anterior part approximately  $aa:ab:bc:cd=10:2:7:4$ ;  $dd$  about three-fifths of the circumference; penial setae very closely paired, long, slender, nearly straight except near distal end, where there is a rather abrupt curve with the terminal part at nearly a right angle with the main part and directed anteriorly. The curved and terminal parts are finely sculptured. Length of each, 2 mm or more; diameter, 0.07 mm or less. The clitellum includes 13-19, is incomplete ventrally, and is slightly tan-colored. Median, ventral, transversely elongate papillae on 11/12, 12/13, 14/15, 15/16, and 16/17. Paired ventral papillae on 19/20 and in most specimens on 20/21. Spermathecal pores on 7/8 and 8/9 in line with setae  $ab$ .

Septa 6/7-10/11 are strongly thickened and 11/12 and 12/13 less thickened. Calciferous gland in 10-15. The pair of sperm ducts of either side remain separate and unite with the prostate duct very near its proximal end. Spermathecae paired in 8 and 9.

*Material.*—Ten specimens were collected at Netarts, Oreg., and received in February 1931. The specimen selected as the holotype (U.S.N.M. no. 20245) was split in the median sagittal plane of somites 1-22, and one-half was removed and cut into transverse sections. Transverse and longitudinal sections from two other specimens were also made and studied.

*External characters.*—When collected the specimens apparently had their length much decreased by strong contraction, with a resulting increase in the diameter. The length of the preserved specimens is probably not much more than half of that which they might sometimes have had when crawling about under normal conditions. The type specimen is about 105 mm long, the maximum diameter is about 8 mm in the region of the eighth somite, and the average diameter is about 6 mm. The average length of eight specimens is 101 mm, with extremes of 95 and 110 mm. The average maximum diameter of the eight specimens is 7.8 mm, and the average of the average diameters is 5.6 mm. The diameter midway of the length of the clitellar region is less than elsewhere and is 4.5 mm in the type, and 4.8 mm is the average in the eight specimens. The number of somites is 202 in the type, and in eight specimens the average number is 200, with extremes of 186 and 217.

The setae of the anterior region are located with difficulty because of their small size. They have a length of about 0.5 mm or less and a diameter of 0.04 mm or less. The surface of the distal part is but slightly sculptured and is nearly as smooth as that of the proximal part. The setae are noticeably lacking in a few anterior somites. In the part of the type specimen that was sectioned the setae *a* were present only in somites 3, 5, and 10; setae *b* in 5, 7, and 10; and setae *c* and *d* were lacking in 1–10. There were somewhat fewer setae lacking in other sectioned specimens. Setal sacs were present in normal positions where setae were lacking. The penial setae (*a* and *b* of 18) are very different in size and form from the ordinary setae. Each of the two pairs is in a depression, and the setae protrude from the wall a distance of 1 mm or more in most specimens. Each of the penial setae examined is somewhat over 2 mm in length and but slightly curved except near the outer end, where there is a decrease in diameter and a rather abrupt curve, with the terminal part at nearly a right angle with the main part and directed anteriorly. The terminal part including the strongly curved part has rather fine sculpturing, but the greater part of each seta is smooth-surfaced and approximately 0.07 mm in diameter in the largest specimen and somewhat less in a smaller specimen. The spacing of the setae is somewhat variable and in the anterior part of the worm is approximately  $aa:ab:bc:cd=10:2:7:4$ ;  $dd$  is about three-fifths of the circumference.

The prostomium is small and prolobic. The first six somites are biannulate or partially triannulate, and the following ones are definitely triannulate. The clitellum includes somites 13–19 and in one specimen encroaches somewhat on 20. It is incomplete on the median ventral surface. In some specimens it is somewhat tan-

colored, but otherwise there is a lack of pigmentation in the preserved specimens studied. Transversely elongate, median, ventral papillae on 11/12, 12/13, and 14/15-16/17 are present in all the specimens. Paired ventral papillae on 19/20 and 20/21 are present on most of the specimens and are lacking on 20/21 in one of them.

Dorsal pores are present posterior to the clitellum. Nephridiopores are very small and situated near the anterior margins of somites, beginning with the second one. The number to the somite is somewhat variable, commonly 7 or 8 on each side. There is one pair of male pores on somite 18, laterad of the penial setae and very close to them. Oviducal pores are paired on 14, slightly anterior to the ventral setae, and mesad of seta line *a*. Spermathecal pores are paired on 7/8 and 8/9 and in line with the setal pairs *ab* of the corresponding sides.

*Internal characters.*—Septum 5/6 is not thickened; septa 6/7-10/11 are strongly thickened; 11/12 and 12/13 are less thickened and the following ones not thickened. A well-defined buccal cavity and a pharynx are present. The thickened dorsal wall of the pharynx is connected with the body wall by numerous radiating muscular fibers. A powerful gizzard is present in somite 5. The lumen of the esophagus in 6-8, the anterior part of 9 is relatively small, and the lining epithelium forms several longitudinal folds. In the posterior part of 9 the lumen of the esophagus is much enlarged, and the epithelial lining has numerous thin folds reaching nearly to the middle of the lumen. In 10-15 similar and larger pouchlike evaginations with numerous thin folds of the lining layer are formed. They are largest laterally with the diameter of the esophagus about one-half as great as that of the body. The appearance of transverse sections of these enlargements is similar to that of the calciferous glands of *Lumbri- cidae* and of some species of *Diplocardia*. There is a lack of longitudinal chambers extending through consecutive somites and also a lack of a secondary lumen produced by a fusion of the inner edges of the folds. The diameter of the esophagus is much reduced where it passes through the septa. In 16-18 the diameter is considerably less than in 15, and there is but little development of folds. Posterior to 18 the alimentary tract is much enlarged and becomes the intestine and a definite typhlosole is present. The circulatory system lacks subneutral and lateroneural vessels. A supra-esophageal vessel is present in the region of the calciferous gland. Paired dorsal hearts are present in 7-9, and much larger dorso-esophageal hearts are paired in 10-13. Micronephridia are present in 2 and following somites, eight to ten on each side of somites 2-4 and seven or eight on each side of other somites that were examined.

Spermaries and spermiducal funnels are paired in 10 and 11. The sperm ducts of either side are not united but are closely parallel until they reach their outlets into the prostate duct very near its proximal end. Paired sperm sacs in 11 and 12 have their openings into 10 and 11, respectively, through the septa 10/11 and 11/12 near the ventrolateral esophageal wall. One pair of tubular prostates is present in 18. The glandular part of each is long and contorted and occupies a relatively large space. The duct of each has muscular walls and serves as an outlet for the gland products and also for the sperm cells, which enter it near the proximal end through the sperm ducts of the same side. Ovaries and oviducal funnels are paired in 13 and oviducts in 14. No ovisacs were recognizable. A pair of spermathecae is present in each of somites 8 and 9. Each spermathecal duct is short and has a thick muscular wall, and the inner lining is irregularly folded. In the anterior wall of each duct there is included a diverticular chamber connected by a small duct with the lumen of the spermathecal duct. The ampulla of each spermatheca has walls that are thinner near the duct, and the lining layer is irregularly folded. In each of three sectioned specimens, the ampullae in 9 are somewhat larger than those of 8, and the part of the wall on the side in contact with the body wall is very thin and without any folds of the lining layer. In a fourth specimen the difference in the thickness and folding of the wall was less pronounced.

MEGASCOLIDES EISENI, new species

*Distinguishing characters.*—Length of preserved specimens, 115–170 mm. Average of maximum diameters,  $6\frac{2}{3}$  mm; near middle of clitellum, 4.5 mm. Number of somites, 191–205. Setal distances in anterior part, approximately  $aa:ab:bc:cd=20:3:12:5$ ; in posterior part  $aa:ab:bc:cd=12:3:9:5$ ;  $d\ell$  about three-fifths of circumference; penial setae long, nearly uniformly curved in plane transverse to longitudinal axis of the worm; distal end finely sculptured and projecting from body in a ventrolaterad direction; length 1.8 mm and diameter 0.045 mm in most of length. Clitellum incomplete ventrally and includes 13–19 and sometimes a part of 20; slightly tan-colored. Median ventral papillae on either, or both, of 9/10 and 10/11; paired ventral papillae on 16/17 and 19/20–21/22 or 22/23. Male pores on 18 close to penial setae and laterad of them on laterally elongated elevations. Spermathecal pores, but one pair and at anterior margin of 9, near setal line  $b$ .

Septa 6/7–11/12 strongly thickened, 12/13 less thickened. Calcareous gland in 10–14. The two sperm ducts of either side remain separate and unite with the prostate duct of the same side near its proximal end. Spermathecae, but one pair and in 9.

*Material.*—Six specimens were collected at Multnomah, Oreg., in February 1931. The specimen selected as the holotype (U.S.N.M. no. 20246) was split in the median sagittal plane of somites 1–21, and one-half was removed and cut into transverse sections, which are the source of most of the data concerning the internal anatomy.

*External characters.*—The length of the type specimen is 131 mm; the maximum diameter is 7 mm, and the average diameter is approximately 5 mm. The average length of the six specimens is 135 mm, with extremes of 115 and 170 mm. The average of the maximum diameters of the six specimens is about 6.6 mm, and of the average diameters about 4.5 mm. The diameter near the middle of the clitellar regions is somewhat less than that in adjacent regions of the preserved specimens. The number of somites is 202 in the type, and the average number in the six specimens is 198, with extremes of 191 and 205.

The setae are relatively small in the anterior region, usually not over 0.35 mm in length and with a maximum diameter of 0.028 mm. They are minutely sculptured on the distal part. Most of the anterior somites have their full quota of eight setae to the somite. In the anterior region the spacing is approximately  $aa:ab:bc:cd=20:3:12:5$ , with  $dd$  about three-fifths of the circumference. Posteriorly it is more nearly  $aa:ab:bc:cd=12:3:9:5$ , with  $dd$  but slightly more than one-half of the circumference. The penial setae are long and slender, with a nearly uniform rate of curvature but somewhat increased in the distal region. The curvature is in a plane transverse to the longitudinal axis of the worm, with the convex side mesad. Only a small part of the length is protruded, and this is curved laterad. The distal part is finely sculptured, and the end is relatively blunt. The length is about 1.8 mm, and the diameter is 0.045 mm throughout most of the length. With each penial seta of the type specimen there are closely associated reserve setae, of which one is about full size and others are only partially grown.

The prostomium is small and prolobic. The anterior six somites are biannulate or partially triannulate and the others definitely triannulate. The clitellum includes 13–19 and invades 20 in two specimens. It is incomplete ventrally and in some specimens seems slightly tan-colored. Median ventral papillae are present on 9/10 on each of two specimens, on 9/10 and 10/11 on each of two other specimens including the type, and only on 10/11 on another one. The papilla on 10/11 is the larger. Paired ventral papillae on 16/17 are present in each of the six specimens, and one of them has an additional papilla on the left side of 15/16. On each of most of the specimens there are paired ventral papillae, transversely elongate, on 19/20–22/23, while on the type specimen they are on 19/20–21/22.

Dorsal pores are present posterior to the clitellum. Nephridiopores are very small and inconspicuous near the anterior margins of the second and following somites. They are usually eight or nine in number on each side of the few anterior somites of which sections were studied. There is a pair of male pores on 18, laterad of the penial setae and very near to them. They are borne on elevations that are transversely elongated and are due in part to an increased thickness and development of the musculature of the body wall in that region. Oviducal pores are paired on 14 and are slightly anterior to the ventral setae and midway between seta line *a* and the median ventral line. There is but one pair of spermathecal pores, and they are located at the anterior margin of 9 and near seta line *b*.

*Internal characters.*—The septa 6/7–11/12 are strongly thickened, 12/13 less thickened, and other septa not thickened. The pharynx has a thick muscular dorsal wall, and a powerful gizzard is present in 5. A calciferous gland is present in 10–14. The enlargements of the esophagus between the septa have numerous folds of the lining layer reaching nearly to the middle of the lumen. These folds are not quite so numerous and crowded as those found in *Megascolides michaelseni*, and the glandular development is intermediate between that found in the gland of that species and that in the gland in *M. americanus*. The intestine begins at about 19. A typhlosole is present. Dorsal, ventral, and supra-esophageal vessels are present and also hearts in 7–13, but owing to the fact that the longitudinal vessels were in part included in the unsectioned part of the worm a complete study has not been made of all the connections of the various hearts with the longitudinal vessels. The data obtained indicate that the relations are like those found in the other species here described. The nephridia are of the micronephridial type, with about eight on each side of somites beginning with the second one. The pores and ducts are very small and difficult to trace even in sections.

Spermaries and spermiducal funnels are paired in 10 and 11. The sperm ducts of either side are not united but continue their courses closely parallel to each other. They reach the wall of the prostate duct near its union with the gland. Here they enter the wall, which they follow until they open into the lumen of the duct at about one-third of the length of the duct from its proximal end. Paired sperm sacs in 11 and 12 open through septa 10/11 and 11/12 into 10 and 11, respectively, in close proximity to the esophagus. One pair of tubular prostate glands is present in 18. The glandular part is long and contorted. Ovaries and oviducal funnels are paired in 13 and oviducts in 14. No ovisacs were recognizable. There is but one pair of spermathecae, and they are of large size in somite 9.

The ducts are short with thick muscular walls and longitudinal folds in the inner lining. A diverticular chamber with irregularly folded lining is buried in the anterior wall of each duct and its cavity is connected with the lumen of the spermathecal duct by a small channel.

A comparison of the data in the foregoing descriptions seems to the writer to justify the recognition of the two new species *M. cascadiensis* and *M. macelfreshi*, of each of which only a single specimen is available. The much greater number of somites, the paired papillae of the somites anterior to the clitellum, the much simpler type of calciferous gland development, and the location of the communication of the sperm ducts with the prostate glands would preclude the inclusion of either of them with either of the other new species. They differ from *M. americanus* in having paired papillae anterior to the clitellum, having the sperm ducts of either side remaining separate until they reach the prostate gland, in the character of the penial setae, and in the extent of the clitellum. They differ from each other in the marked difference in the spacing of the setae, which is much greater than one would expect to find between two specimens of the same species. There are also differences of less importance in the lengths of the penial setae and the number of papillae anterior to the clitellum.

#### Genus PLUTELLUS E. Perrier

*Plutellus* PERRIER, Arch. Zool. Exp. et Gén., vol. 2, p. 250, 1873.

The majority of the large number of species of the genus *Plutellus* already described are from the Australian region. Although the description of *P. heteroporus*, on which the genus was founded by Perrier in 1873, was based on two specimens collected in Pennsylvania, no other specimens of this species have yet been reported, nor have other species of the genus been found in the eastern part of the United States. Benham (1892) described a species, *P. perrieri*, based on two specimens collected on the Queen Charlotte Islands, British Columbia. Eisen described a genus, *Argilophilus*, to which he assigned three species found in California and one in Guatemala but which are now assigned to *Plutellus* (Eisen, 1894 and 1900). Michaelsen (1921) described *P. sierrae* from California.

The species of *Plutellus* here described from Oregon are associated with species of *Megascolides*, and representatives of both of these genera are also found in Australia, Tasmania, and India.

Important characters of the genus *Plutellus* as given by Stephenson (1930, p. 833) are: "Setae eight per segment. Male pores paired or single; female pores mostly paired; spermathecal pores end at furrow 8/9 or on segment ix, a single pair, or a series of two to five

pairs, or five single pores. A gizzard in the region of segments v-vii. Purely meganephridial. Prostates tubular, with simple unbranched canal."

**PLUTELLUS GARLOUGH, new species**

*Distinguishing characters.*—Length of preserved specimens, not strongly contracted, averages about 115 mm. Diameter, approximately 4 mm. Average number of somites, about 166. Setae are widely paired, approximately  $aa:ab:bc:cd=5:2:3:3$ , anterior to the clitellum. Penial setae long, slender, curved in sagittal plane with convex side anterior; length about 1 mm and diameter slightly less than 0.02 mm. Clitellum 13–18, much thinner on midventral part. Ventral median papilla, small and circular on 10/11; occasionally on 9/10 or 11/12, and 15/16. Paired transversely elongate papillae on 19/20 and in some specimens on one or more following somites. Male pores on 18 in seta line *b* and closely approximated to penial setae. Oviducal pores on 14, about midway between seta line *a* and the midventral line. Spermathecal pores at 7/8 and 8/9 in seta line *b*. Calciferous gland of simpler type, includes posterior part of 9 and extends to middle of 15. Paired dorso-esophageal hearts seem to be lacking in thirteenth somite. Spermathecae of 8 are somewhat smaller, and the diverticulum of the duct has one chamber with ridged lining, while there are three or four such chambers in the diverticulum of each of the spermathecae of 9.

*Material.*—About 20 specimens were received from F. E. Garlough in March 1931 that had been collected at Multnomah, Oreg., in the preceding month. Most of them were apparently not much contracted, and several had the reproductive organs fairly well developed. Transverse sections were prepared from one-half of the anterior 19 somites of the holotype (U.S.N.M. no. 20249) and sagittal sections from one-half of the anterior 19 somites of the paratype.

*External characters.*—No definite pigmentation is obvious in the preserved specimens. The length of 11 apparently complete ones that were measured is 105–125 mm, and that of the type specimen is 113 mm. The diameter is approximately 4 mm, a little less posteriorly. Somites 10–12 are definitely less in diameter than adjacent ones. The number of somites is 157–176, with an average of 166, and in the type there are 167. The setae spacing is somewhat variable and anterior to the clitellum is approximately,  $aa:ab:bc:cd=5:2:3:3$  and posterior to the clitellum  $aa:ab:bc:cd=7:3:5:4$ ;  $dd$  is about one-third of the circumference. The setae are slender and variable in length and anterior to the clitellum 0.4–0.525 mm in length. The distal part has fine sculpture, most evident near the tip. Setae *a* and *b* of 18 are long, slender penial setae, with a nearly



uniform rate of curvature in a sagittal plane with the convex side directed anteriorly. The length in a sectioned specimen is about 1 mm, and the diameter midway of the length is about 0.015 mm and near the proximal end 0.017 mm. The distal part tapers gradually near the end and is finely sculptured. The distal ends protrude but very little and are very closely approximated with the male pore and near seta line *b*.

The prostomium is epilobic. The anterior five somites are biannulate, and others are triannulate. The clitellum includes 13–18. It is much thinner on the median ventral part of 13–15 and is undeveloped on 16–18 between seta lines *a*. Papillae are variable in number and locations. Ventral median papillae of small size and circular outline are found anterior to the male pores in 20 specimens. In 14 of them, including the type, such papillae are found only at 10/11. In three others such papillae are found at 10/11 and also at 15/16. In one specimen the papilla is at 9/10. In another there are papillae at 9/10 and 10/11, and in the paratype they are at 10/11 and 11/12. Posterior to the clitellum the papillae are transversely elongate and the anterior pair are at 19/20 in line with *ab*. Other pairs, when present, become progressively more approximated and are sometimes in contact at the midventral line. Each of 19 specimens has a pair on 19/20; in nine specimens there is an additional pair on 20/21; and in two there is a third pair on 21/22. In one abnormal asymmetrical specimen, in which the organs of a part of the left side are one somite anterior to the normal position, there are four pairs of papillae, of which those of the left side are at 18–21 and those of the right side at 19–22. The anterior median papilla of this specimen is at 10/11. Dorsal pores are present posterior to the clitellum, but none have been found in the anterior somites. Nephridiopores are paired on each of most somites but irregularly distributed. Some open on seta line *d* and others on seta line *e* in the region in which sections were made. Each of the pair of male pores on 18, laterad of the penial setae and closely approximated with them, is located on the summit of an elevation in seta line *b*. Oviducal pores are paired on 14 and located a little anteriorly of the setae and midway between the midventral line and seta lines *a*. There are two pairs of spermathecal pores at 7/8 and 8/9 and in seta lines *b*.

*Internal characters.*—The most strongly thickened septa are 7/8–10/11; less thickened are 6/7 and 11/12. The dorsal wall of the pharynx is much thickened and includes an evaginated chamber with diverticula. A powerful gizzard is present in 5. The lining layer of the esophagus in the anterior part forms longitudinal folds, approximately 15 in number. In the posterior part of somite 9 there

is an increase in diameter, the number of folds is about doubled, the folds are much thinner and extend nearly to the middle of the lumen. This type of structure is continued in following somites to the middle of the fifteenth and is similar to that of the simpler type of calciferous glands in some species of *Diplocardia* and *Megascolides*. Posterior to 15 there is a marked decrease in the number and height of the folds of the lining epithelium and in the diameter of the esophagus. The enlarged intestinal region begins in 18 and a typhlosome is present.

Nephridia are paired in the second and following somites. Dorsal and ventral blood vessels are present; subneural and lateroneural vessels are lacking. Short, longitudinal vessels connected with the blood plexus of the median dorsal wall of the esophagus in 8-13 seem to be representative of a supra-esophageal vessel. Short longitudinal vessels on each side of the median ventral part of the esophagus in 8-13 seem to represent a pair of subesophageal or laterolongitudinal vessels. Paired dorsal hearts are present in 7-9, and paired dorso-esophageal hearts are present in 10-12. No trace of hearts was found in the thirteenth somite of either of the sectioned specimens.

Spermaries and spermiducal funnels are paired in 10 and 11, and the sperm ducts of either side unite in 13 and form a single duct, which unites with the prostate gland in 18. The exact place of union with the gland could not be determined in either series of sections. Paired sperm sacs in 11 and 12 communicate with 10 and 11, respectively, near the esophagus. A pair of prostate glands is present in 18. The glandular part is long and contorted and of the tubular type. The muscular duct of each is shorter, of smaller diameter, and also contorted. Ovaries and oviducal funnels are paired in 13 and oviducts in 14. No ovisacs were found. Paired spermathecae are present in 8 and 9, those of 9 being largest. The ampullae have moderately thin walls, and the lining layer has numerous low ridges. The ducts are short and have thick walls, and the lining layer forms several ridges. A short diverticulum with one chamber having a ridged lining is developed on the anterior wall of each of the ducts in 8, and in a similar position a short diverticulum with three or four chambers is formed on the wall of each of the ducts in the ninth somite.

#### PLUTELLUS OREGONENSIS, new species

*Distinguishing characters.*—Length of strongly contracted specimens, approximately 50 mm. Diameter, about 4 mm. Average number of somites in five specimens is 117. Setae are widely paired, with spacing in anterior region approximately  $aa:ab:bc:cd=$

6 or 7:3:5:5;  $dd$  about one-third of circumference. Penial setae long, slender, curved in longitudinal plane with distal end finely sculptured and protruding but little. Length approximately 0.9 mm and maximum diameter slightly less than 0.03 mm. Clitellum includes 13-18 and much thinner in midventral part. Transverse median papilla on 9/10 between seta lines  $b$ . Paired transverse papillae on 19/20 in line with ventral setae. Male pores on 18, in seta line  $b$  and close to penial setae. Oviducal pores nearer to midventral line than to seta line. Spermathecal pores at 7/8 and 8/9 in seta line  $b$ . Calciferous gland much more highly developed in 15 and 16 than elsewhere. Sperm ducts of either side unite in 12, and the ducts thus formed enter the prostate ducts near their connection with the prostate glands. Spermathecae of 9 somewhat larger but otherwise similar to those of 8.

*Material*.—Six specimens were received from F. E. Garlough in March 1931 that had been collected in the preceding month at Multnomah, Oreg. They were all strongly contracted and most of them in a state of sexual inactivity. Sagittal sections from one-half of the anterior part of the holotype (U.S.N.M. no. 20247) and transverse sections of the other half were prepared.

*External characters*.—The average length of four specimens is about 49 mm and that of the type 53 mm. The diameter is about 4 mm in most of the specimens, and there is no noticeable contraction anywhere, other than near the extremities. The number of somites in five apparently entire specimens is 108-124, with an average of 117, and in the type there are 124. The setae are widely paired and the spacing anteriorly about  $aa:ab:bc:cd=6$  or  $7:3:5:5$ ;  $dd$  is about one-third of the circumference;  $ab$  is somewhat less in the clitellar region and  $aa$  correspondingly greater. The penial setae are long, slender, and curved in a plane nearly longitudinal, with the convex side anteriad. The rate of curvature is a little more pronounced near either end than in the middle, but is nowhere very abrupt. The distal ends of the setae are finely sculptured with transverse ridges, which are most definite on the penial setae. The length of the penial setae is slightly more than 0.9 mm, and the diameter near the proximal end is slightly less than 0.03 mm and still less toward the distal end. The distal ends protrude but little and are closely approximated to each other and to the male pores.

The prostomium is small and epilobic. Posterior to 6 the somites are triannulate. The clitellum includes 13-18 and on the midventral side of 14-16 is much thinner than dorsally and is still less developed on the ventral side posterior to 16. A transversely elongate, median, ventral papilla on 9/10 and extending on each side to seta line  $b$  is present on the type and on each of most of the other specimens.

A pair of transversely elongate papillae is present on the type and on some other specimens at 19/20, in line with the ventral setae, but none were found elsewhere. No dorsal pores were found in the anterior 18 somites, and in the others they were very inconspicuous. Nephridiopores are present in the second and following somites. There are two in each somite at the anterior margins, but they are irregularly distributed. Those of the first few somites are in seta line *d*, while in other somites they may be located in either of seta lines *b*, *c*, or *d*, or between lines *b* and *c*. Male pores are paired on 18 slightly laterad of the closely associated apertures of the penial setae and with them are borne on the summits of two slight elevations forming the lateral borders of a transverse depression of the ventral surface of the somite. The pair of oviducal pores on 14 are slightly anterior to the ventral setae and nearer to the mid-ventral line than to the seta line *a*. The two pairs of spermathecal pores are at 7/8 and 8/9 in seta line *b*.

*Internal characters.*—Septa 8/9–11/12 are most strongly thickened, and those of 12/13 and 13/14 are but slightly thickened. The dorsal wall of the pharynx has a thickened muscular wall with an evaginated chamber that opens into the lumen of the pharynx. There is a powerful gizzard in 5 that occupies considerable space gained by pushing back the septa of a few following somites. The chief development of calciferous gland structure is in 15 and 16 in which the esophagus is much enlarged; the folds of the lining layer are much more numerous and much wider than elsewhere, and the wall is more extensively supplied with large blood vessels. There is also a definite tendency for edges of the folds to unite in some places and thus partially form a secondary lumen. In 17 there is a marked decrease in the number and width of the folds and in the diameter of the esophagus. In the posterior part of 18 and 19 there is an increase in the diameter of the alimentary tract and lumen and the beginning of the intestinal region with a definite typhlosole present. Nephridia are paired in the second and following somites, and the pores are inconspicuous and irregularly distributed. Paired dorsal hearts are present in 7–9, and paired dorso-esophageal hearts in 10–13.

Spermaries and spermiducal funnels are present in 10 and 11, and the sperm ducts of either side unite in 12 and form a single duct, which unites with the prostate duct quite near its union with the gland. Paired sperm sacs in 11 and 12 open into 10 and 11 through the septa 10/11 and 11/12 very near the esophagus. Prostate glands are paired in 18. The glandular part is long, contorted, and of the tubular type. The muscular duct is shorter and also contorted. Ovaries and oviducal funnels are paired in 13 and oviducts in 14. Ovisacs not found. Spermathecae are paired in 8 and 9; those of

9 are somewhat larger, but otherwise they are similar. The ducts are short with thick muscular walls and one or two short diverticula containing chambers having folds in the inner layer and a lumen opening into the duct. The ampullae are large and with rather thin walls.

**PLUTELLUS OREGONENSIS SWIFTAE, new subspecies**

*Distinguishing characters.*—Length of preserved specimens, not strongly contracted, 60–77 mm. Diameter, 2.5–3.5 mm. Number of somites, 116 in each of two specimens. Setae are widely paired; anterior to the clitellum approximately  $aa:ab:bc:cd=4:1:3:3$ ;  $dd$  about one-third of circumference. Penial setae similar to those of the typical form in dimensions, form, and location. Transversely elongate papillae on 7/8, 8/9, and 9/10 and extending laterally to seta lines  $a$ . Normally, apparently one pair of papillae on 19/20. (Asymmetrical in type specimen.) In 15 and 16 a calciferous gland enlargement is present; numerous wide folds extending nearly to the middle of the lumen, but less highly developed than in the typical form. Nephridia, circulatory, and reproductive organs similar to those of the typical form.

*Material.*—The description is based on two specimens collected by F. M. McElfresh in April 1901 in the bottomlands of Marys River in the Cascade Mountains and sent by him to the writer. Only one of the specimens, the holotype (U.S.N.M. No. 20248), was sexually mature, and the anterior 24 somites of this were divided in the median sagittal plane and sagittal sections were made from one half and transverse sections from the other half. This form is similar to *P. oregonensis* in so many respects that it seems desirable to treat them as subspecies of the same species, and the selection of the other one as the typical form is due chiefly to the fact that a greater number of specimens of that form were available for study. The more important differences noticed are in the number and location of the genital papillae.

The two specimens were less contracted than those of the typical form, probably as a result of different methods of preservation. Length of type, 77 mm; diameter, 3–3.5 mm. Other specimen, 60 by 2.5–3 mm. Each specimen has 116 somites. Triannulate somites begin at the eighth. The clitellum on 13–18 is complete on 14–16, with the ventral part about one-third as thick as on the dorsal side. Ventral median papillae are present on 7/8, 8/9, and 9/10 and extend laterally to seta lines  $a$ . Paired papillae posterior to the clitellum are asymmetrical in the specimen studied, being at 19/20 on the left side and at 20/21 on the right side. Anterior to the clitellum approximately  $aa:ab:bc:cd=5:2:4:4$  and posterior to the clitellum  $aa:ab:bc:cd=4:1:3:3$ ;  $dd$  is about one-third of the circumference.

*Holotype*.—U.S.N.M. no. 20248.

*Remarks*.—The subspecies is named in recognition of Miss Lola Swift, graduate student at the University of Illinois in 1917, who made a careful study of it and contributed some of the data used.

#### LITERATURE CITED

The following list includes titles of papers to which reference has been made, and in some of them may be found lists of other literature dealing with American representatives of *Megascolides* and *Plutellus*.

BENHAM, WILLIAM BLAXLAND.

1892. Descriptions of three new species of earthworms. Proc. Zool. Soc. London, 1892, pp. 136-152, 2 pls.

EISEN, GUSTAV.

1894. On California Eudrilidae. Mem. California Acad. Sci., vol. 2, pp. 21-62, 18 pls.

1900. Researches in American Oligochaeta, with especial reference to those on the Pacific coast and adjacent islands. Proc. California Acad. Sci., ser. 3, vol. 2, pp. 85-276, 10 pls.

MCCOY, FREDERICK.

1878. Prodromus of the zoology of Victoria, vol. 1, decade 1, pp. 21-25, 1 pl.

MICHAELSEN, WILHELM.

1921. Neue und wenig bekannte Oligochäten aus skandinavischen Sammlungen. Arkiv für Zool., vol. 18, no. 19, 25 pp., 1 pl.

PERRIER, EDMOND.

1873. Étude sur un genre nouveau de lombriciens (genre *Plutellus*, E. P.). Arch. Zool. Exp. et Gén., vol. 2, pp. 245-268, 3 figs.

SMITH, FRANK.

1897. Upon an undescribed species of *Megascolides* from the United States. Amer. Nat., vol. 31, pp. 202-204.

STEPHENSON, JOHN.

1930. The Oligochaeta, 978 pp., 242 figs. Oxford.



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## OBSERVATIONS ON THE TREMATODE GENUS BRACHY- COELIUM DUJARDIN

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DURING the past five years I have examined many vertebrate animals, chiefly amphibians and reptiles, from various places over a portion of the Southeastern United States, mainly from two localities: New Orleans, La., and vicinity and Athens, Ga., and vicinity. These examinations have yielded a great variety of parasitic forms, many of which appear to be new to science.

Collections were made personally from the various places mentioned in the text, and all animals were brought into the laboratory before being examined. Except in instances in which only a very few animals were collected from any one given locality, the hosts were examined at various times after collections were made. By this method those parasites collected immediately after the hosts were brought into the laboratory could be checked against those parasites having had a longer time in which to mature. This procedure seemed advisable, since in a great many instances specific diagnosis of trematodes depends to a greater or lesser extent on the differences in dimensions of the various organs in the mature stage.

All parasites were studied first while living and then after being fixed. The worms considered in this paper were killed with cold



formalin, the fluid being drawn under the coverslip with filter paper. Worms were allowed to "set" in a somewhat flattened condition before being removed from the slide to a dish of formalin for preservation. All specimens were stained with Bullard's hematoxylin, dehydrated in alcohol, and cleared in cedar oil.

The present paper deals exclusively with members of the trematode genus *Brachycoelium* Dujardin, 1845.

I wish to express my appreciation to Dr. Maurice C. Hall, formerly chief of the zoological division, U. S. Bureau of Animal Industry, for the loan of paratype specimens of *Brachycoelium meridionalis* Harwood and *B. daviesi* Harwood; to Dr. Fred J. Holl, University of Buffalo, for the loan of slides carrying a serially sectioned specimen of *B. trituri* Holl; to Dr. M. C. Hall and Dr. E. W. Price, U. S. Bureau of Animal Industry, for reading the manuscript; and to James F. Denton for assistance in the technical work involved.

#### Genus BRACHYCOELIUM Dujardin, 1845

The genus *Brachycoelium* (as a subgenus of *Distoma*) was erected by Dujardin (1845) for the reception of the species *Brachycoelium crassicolle* (Rudolphi) (= *Distoma crassicolle* Rudolphi, 1809). Looss (1899) utilized the genus as the type around which to establish his subfamily Brachycoeliinae. Later S. J. Johnston (1912) elevated Looss' subfamily to the rank of family, Brachycoeliidae, which now includes the three well-known genera *Brachycoelium* Dujardin, 1845, *Glyphelmims* Stafford, 1905, and *Mesocoelium* Odhner, 1911. Faust (1929) included the family Brachycoeliidae in his superfamily Dicrocoelioidea.

The genus *Brachycoelium* is characterized as follows: Body elongated, more or less cylindrical; cuticle with or without (?) spines; suckers subequal; acetabulum at about equator of body; intestinal caeca short, diverging posterolaterally from bifurcation, ending short of level of acetabulum; ovary anterior (posterior in *B. lynchi*) to opposed testes, slightly smaller than male glands; genital pore ventral, in midline immediately in front of acetabulum; uterus sinuous, rather simple; ova small, thick-shelled, operculated; vitellaria follicular, anterior to level of acetabulum; excretory bladder Y-shaped, with short cornua; parasitic in intestine of amphibians and reptiles.

Since the erection of the genus for the inclusion of *B. crassicolle*, seven other species have been added as follows: By Stafford (1900), *B. hospitale*; by Nicoll (1914), *B. obesum*; by Holl (1928), *B. trituri*; by Harwood (1932), *B. storeriae*, *B. meridionalis*, and *B. daviesi*; and by Ingles (1936), *B. lynchi*. This paper adds five new species to the genus.

## BRACHYCOELIUM CRASSICOLLE (Rudolphi, 1809)

I have no complete description of this species and am unable, from the descriptions and illustrations available, to assign any of the specimens in the present collection to it. *B. crassicolle* is referred to many times in the literature and appears to be the only member of the genus thus far recorded for continental Europe. In discussing the species, Stafford (1903) states that *B. hospitale* is very similar to *B. crassicolle*. "The internal organization, so far as it is known for both worms and so far as one can judge who has a practical acquaintance with only one of them, appears to be identical . . . It would seem that *B. hospitale* is somewhat smaller and slenderer than *B. crassicolle*." Nicoll (1914) remarks: "At first sight they (*B. obesum*) appear to be identical with *B. salamandrae* (= *B. crassicolle*), but their exceedingly small size and the fact that even the smallest was fully matured, raised the suspicion that this could not be the case . . . It was difficult, however, to obtain other grounds for regarding them as a distinct species."

## BRACHYCOELIUM HOSPITALE Stafford, 1900

## PLATE 8, FIGURE 1

This species of fluke was described by Stafford (1900) from the Canadian salamanders *Triturus viridescens* and *Plethodon erythronotus*. It has been reported recently by Harwood (1932) from the grass frog (*Rana sphenocephala*) from the vicinity of Houston, Tex. I assign to this species eight specimens taken from the duodenum of the salamanders *Ambystoma opacum* and *Plethodon glutinosus*, collected from the vicinity of Pearl River, La. In this material there are certain differences in anatomical details that may be noted. Most of the specimens fall within the range of the smallest forms described by Stafford. The acetabulum is consistently smaller than the figures given by Stafford would indicate, making the size ratio of the oral sucker and acetabulum approximately 8:5. The intestinal caeca terminate anterior to the level of the anterior margin of the acetabulum. The ova seem to be a few microns narrower than the dimensions given in the original description. The testes average about 0.18 mm long and 0.17 mm wide, being thus slightly larger than the ovary, which measures 0.11 mm long and 0.134 mm wide. Stafford states that the testes are slightly larger than the ovary. The cuticle very definitely bears spines as far posterior as the level of the testes.

## BRACHYCOELIUM MESORCHIUM, new species

## PLATE 8, FIGURES 2, 3

More than 30 specimens of this species were taken from the small intestine of the salamander *Desmognathus fuscus fuscus*, collected

from the vicinity of Athens, Ga. The specific designation is selected because of the medial position of the testes.

*Description.*—Body moderately large, elongated elliptical in outline, somewhat cylindrical in transsection; 1.3 mm to 2.7 mm long, averaging 1.7 mm; 0.42 mm to 0.69 mm wide, averaging 0.54 mm; widest at level of acetabulum. Cuticle relatively thin throughout, armed with moderately fine spines anteriorly to level of testes. Oral sucker subterminal, 0.165 mm in diameter. Acetabulum 0.116 mm in diameter, located about one-fourth body length, or 0.45 mm, from anterior end of body. Ratio of sizes of oral sucker and acetabulum, approximately 7:5. Prepharynx present, about  $50\mu$  long. Pharynx muscular, 0.04 mm long by 0.07 mm wide, surrounded by numerous rather small peripharyngeal gland cells. Caeca fairly large, 0.21 mm long, 0.09 mm in maximum width, lined internally by a membrane of tall epithelial cells, ending short of level of anterior margin of acetabulum. Ovary alternating from right to left side of midline, always partially dorsal to acetabulum, at level of equatorial plane of acetabulum or slightly in advance of that position, with margin entire, transversely oval, 0.096 mm long by 0.14 mm wide. Oviduct slender, sinuous, arising from medial end of ovary. Oötype at about posterior margin of ovarian side of acetabulum, lined internally by a ciliated membrane. Laurer's canal present. Seminal receptacle flask-shaped. Shell gland rather voluminous, entirely surrounding oötype. Uterus greatly convoluted, descending limb forming half loops on ovarian side, reaching to near posterior margin of body; ascending limb forming half loops in posterior body opposite descending limb, but forming complete loops across body just posterior to testes before passing between testes to make other complete transverse loops in front of testes, then passing to genital pore. Metraterm weakly developed. Ova numerous, thick-shelled, operculated, containing fully matured embryos when oviposited, measuring  $27\mu$  to  $33\mu$  by  $45\mu$  to  $52\mu$ . Vitellaria composed of rather large follicles, tending to form two or three clusters on each side of body, lateral in position, extending from level of posterior margin of acetabulum to level of bifurcation of caeca, overlying caeca to near bifurcation. Yolk ducts single on each side, uniting immediately posterior to shell gland and forming a small crescent-shaped yolk reservoir. Genital pore ventral, in midline just in front of acetabulum. Testes transversely oval, margins entire, with inner margins touching or overlapping midline, one slightly in advance of other, depending on position of ovary (right testis posterior in position when ovary is on right side), situated in area just posterior to acetabulum; right testis 0.112 mm long by 0.143 mm wide; left testis 0.104 mm long by 0.153 mm wide. Vasa efferentia delicate, uniting

on entering cirrus sac. Cirrus sac thin-walled, usually anterior to acetabulum, but sometimes extending posteriad over or around acetabulum to end short of posterior margin of sucker, containing an almost spherical vesicula seminalis, a club-shaped, muscular pars prostatica surrounded by gland cells, a short ductus ejaculatorius, and a weakly developed cirrus. Excretory system (pl. 8, fig. 3) characteristic. Bladder opening through a dorsoterminal pore guarded by a sphincter muscle; main stem of bladder Y-shaped, with short, often indistinct cornua, passing anteriad just under dorsal surface of body, ending near anterior margin of anterior testis. Common collecting tubules relatively long, sinuous, dividing into anterior and posterior collecting tubules and these giving rise to accessory tubules. Flame cells in groups, six groups in each side, each group containing three flame cells. Flame cell pattern of  $2 \times 6 \times 3$  type.

*Host*.—*Desmognathus fuscus fuscus* (Rafinesque).

*Habitat*.—Small intestine.

*Locality*.—Athens, Ga.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 9031.

*Remarks*.—*Brachycoelium mesorchium* shows a close relationship to *B. hospitale* but may be distinguished from that species, as well as from *B. obesum*, *B. trituri*, and *B. lynchi*, the other members of the genus with which it may be confused, by its more nearly equal suckers, the more medial position of the ovary and testes, the configuration and distribution of the vitellaria, and the pattern made by the uterus.

BRACHYCOELIUM GEORGIANIUM, new species

PLATE 8, FIGURE 4

Eight specimens of this species of worm were taken from the small intestine of the grass frog (*Rana sphenoccephala*) collected from the region about Athens, Ga.

*Description*.—Body spindle-shaped, bluntly pointed at both ends, or elongated oval with strongly rounded ends; averaging 1.326 mm long by 0.80 mm wide; widest at level of body equator. Cuticle relatively thin, thicker ventrally than dorsally; armed with spines to near posterior margin of body. Oral sucker subterminal, muscular, slightly elongated oval, 0.206 mm long by 0.191 mm wide. Acetabulum transversely oval, measuring only one-half as much as oral sucker, about one-third body length, or 0.474 mm, from anterior body margin. Ratio of sizes of oral sucker and acetabulum, 2:1. Prepharynx short, about  $20\mu$  long. Pharynx muscular, transversely oval, 0.055 mm long by 0.087 mm wide, surrounded by gland cells. Esophagus slightly longer than transverse diameter of pharynx, surrounded by gland cells. Caeca saclike, 0.175 mm long by 0.091 mm

in greatest width, lined internally by rather tall epithelial cells, ending well in front of acetabulum. Ovary transversely oval, lateral in position, alternating from right to left side of body and varying from a position on level with equatorial plane of acetabulum to a position slightly in front of acetabulum, measuring 0.096 mm long by 0.140 mm wide. Oviduct delicate, arising from medial end of ovary and extending posteromesad for a distance greater than transverse diameter of ovary before forming oötype. Ovarian complex typically that of *B. mesorchium*. Uterus a simple tube descending to near posterior margin of body before returning to genital pore. The entire pattern of the uterus has not been made out because of the numerous dark-brown ova contained in it. Distal end of uterus forming weakly developed metraterm. Ova  $27\mu$  to  $33\mu$  by  $42\mu$  to  $45\mu$ , dark brown in color, thick-shelled, operculated, containing fully developed embryos when oviposited. Vitellaria follicular, occupying a position just under dorsal and ventral surfaces of body, lateral to caeca, seldom overlapping caeca except marginally, extending from level of caudal end of caeca to level of equatorial plane of oral sucker. Yolk ducts single in each lateral field, uniting at level of shell gland and forming yolk reservoir. Genital pore ventral, in midline just in front of acetabulum. Testes elongated oval, with margins entire, in lateral fields opposite acetabulum, depending on position of ovary for exact location (when ovary is on right side, right testis is more posterior in position); right testis 0.223 mm long by 0.164 mm wide; left testis 0.241 mm long by 0.166 mm wide. Vasa efferentia uniting on entering cirrus sac. Cirrus sac club-shaped, usually entirely anterior to acetabulum, sometimes extending posteriad around or over acetabulum as far as its posterior margin, containing an almost spherical vesicula seminalis, a short, bulbous pars prostatica surrounded by gland cells, a short ductus ejaculatorius, and a weakly developed cirrus. Excretory system identical with that observed for *B. mesorchium* except anterior end of bladder always observed to end in short, bluntly rounded cornua.

*Host*.—*Rana sphenocephala* Cope.

*Habitat*.—Small intestine.

*Locality*.—Athens, Ga.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 9030.

*Remarks*.—*Brachycoelium georgianum* probably shows a closer relationship to *B. mesorchium* than to any of the other members of the genus. It can be distinguished from that species, as well as from *B. hospitale*, *B. obesum*, *B. trituri*, and *B. lynchi*, the other members of the genus with which it might be confused, by the extent and configuration of the vitellaria, the position of the ovary, the size,

shape, and position of the testes, the pattern of the uterus, and the general outline of the body.

BRACHYCOELIUM OBESUM Nicoll, 1914

This species of fluke was described by Nicoll (1914) from the intestine of the summer snake (*Contia aestiva*) dying in the London Zoological Gardens. The exact geographical locality from which the snake came was not given in the author's paper. None of the present material came from snakes, and since none of the specimens show any close morphological relationship to the species, it is impossible to assign any specimens in the collection to this species. There are 18 specimens in the present collection that show a closer affinity to *B. obesum* than to any of the other members of the genus, and these are described herein as *B. ovale*.

BRACHYCOELIUM OVALE, new species

PLATE 9, FIGURE 1

Eighteen specimens of this species were taken from the intestine of the ground skink (*Leiopisma laterale*) collected from the vicinity of New Orleans and Pearl River, La., and Calhoun Falls, S. C. The oval outline of the body suggests the specific designation.

*Description.*—Body quite small, elongated cylindrical when extended, almost spherical when contracted, slightly flattened ventrally but strongly arched dorsally; 0.90 mm long when slightly flattened by 0.61 mm wide; widest at level of acetabulum. Cuticle thin, about twice as thick anteriorly as posteriorly, slightly thinner dorsally than ventrally; armed with very fine spines to middle of posttesticular region of body. Oral sucker subterminal, weakly muscular, circular in outline, 0.184 mm in diameter. Acetabulum circular in outline, 0.09 mm in diameter, weakly muscular, lying 0.361 mm behind anterior margin of body. Ratio of sizes of oral sucker and acetabulum, approximately 2:1. Prepharynx long enough to allow transversely oval pharynx, measuring 0.037 mm long by 0.071 mm wide, to lie free behind caudal boundary of oral sucker. Esophagus nonmuscular, 0.07 mm long. Caeca pouchlike, 0.153 mm long by 0.094 mm wide, diverging almost directly laterad, lined internally by a rather low epithelium. Ovary transversely oval, 0.076 mm long by 0.104 mm wide, alternating from right to left side of midline, lateral to and slightly in advance of acetabulum, close behind end of caecum. Oviduct long, extending from inner margin of ovary to near midline at posterior margin of acetabulum before forming oötype. Laurer's canal, receptaculum seminis, and shell gland present. Uterus fairly simple, greatly convoluted, descending to near posterior margin of

body by a series of wavy loops on side of body opposite ovary, ascending through a similar course on opposite side of body to region of testes, here making complete transverse loops both posterior and anterior to testes before passing to genital pore. Metraterm weakly developed. Ova thick-shelled, operculated, containing fully developed embryos when oviposited,  $27\mu$  to  $30\mu$  by  $39\mu$  to  $45\mu$ . Vitellaria follicular, placed in superficial mesenchyme of lateral and dorsal regions of body, extending from level of anterior margin of ovary to anterior margin of oral sucker, not overlapping caeca. A single yolk duct from each side fusing with its neighbor in region just posterior to acetabulum to form yolk reservoir. Genital pore ventral, in midline just in front of acetabulum. Testes large, equal, 0.145 mm in diameter, at about level of equatorial plane of body, slightly behind level of acetabulum, one slightly in advance of other (when ovary is right, right testis is more posterior), or directly opposite. Vasa efferentia uniting on entering cirrus sac. Cirrus sac club-shaped, reaching to caudal margin of acetabulum, containing vesicula seminalis, pars prostatica with its gland cells, ductus ejaculatorius, and weakly developed cirrus. Excretory system typically that of the genus as described for *B. mesorchium*.

*Host*.—*Leiopisma laterale* (Say).

*Habitat*.—Small intestine.

*Localities*.—New Orleans and Pearl River, La., and Calhoun Falls, S. C.

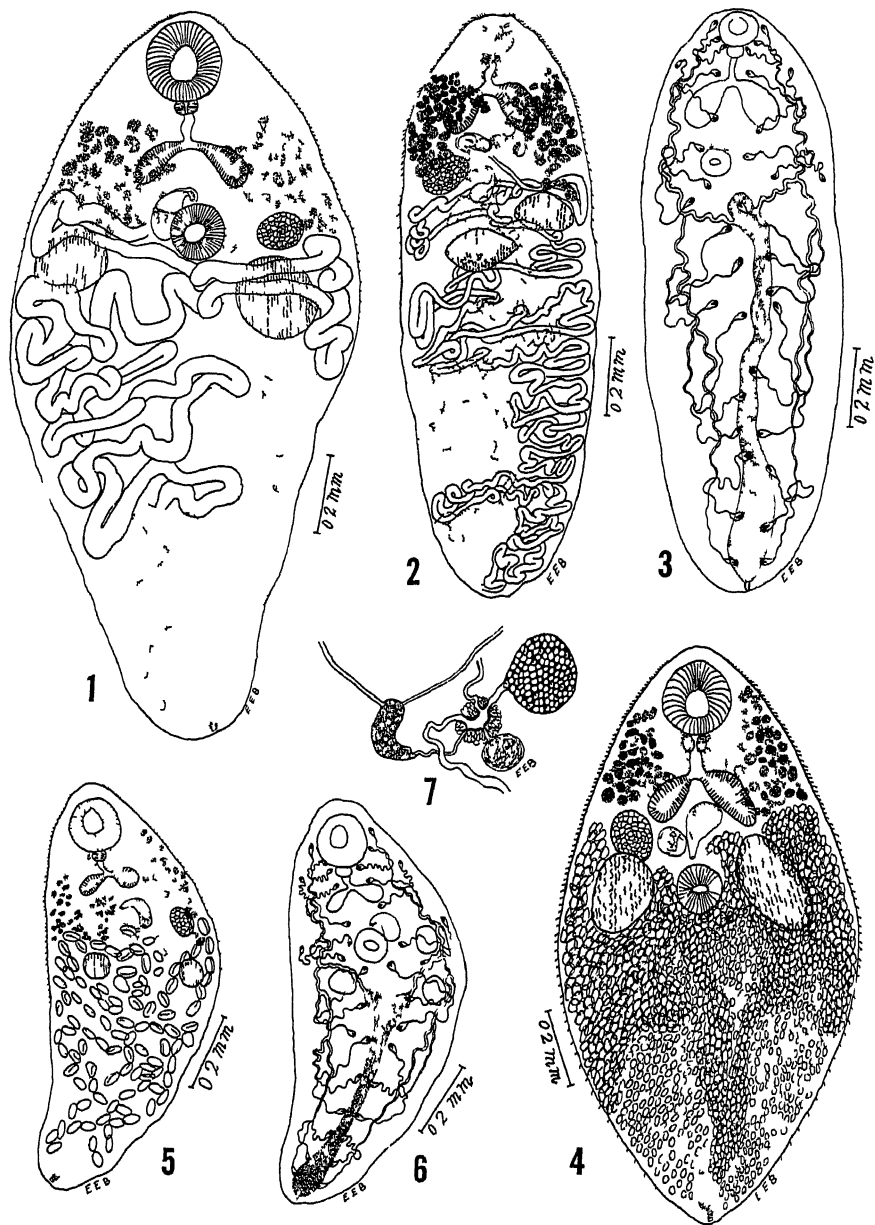
*Type specimen*.—U.S.N.M. Helm. Coll. no. 9028.

*Remarks*.—*Brachycoelium ovale* perhaps shows a closer relationship to *B. obesum* and *B. lynchi* than to any of the other members of the genus. The smaller size of the suckers, the general size and shape of the body, the smaller ova, the extent and distribution of the vitellaria, and the position and size of the reproductive glands are sufficient to separate it from its nearest relatives.

#### BRACHYCOELIUM TRITURI Holl, 1928

##### PLATE 8, FIGURES 5-7

*Brachycoelium trituri* was described by Holl (1928) from the intestine of the spotted newt (*Triturus viridescens*) collected at Durham, N. C. The form appears to be a valid species, although Holl's description was too brief to include morphological details, only measurements being given for the various organs. I am able, however, to assign to this species five specimens from the small intestine of the grass frog (*Rana sphenoccephala*) collected at Harvey, La., two specimens from the small intestine of *Pseudacris occidentalis* collected at Kenner, La., and five specimens from the small intestine of *Desmognathus fuscus fuscus* collected at Athens, Ga. Certain varia-



1 *Brachycoelium hospitale* Stollard. Ventral view of specimen from intestine of *Imbyroma opacum*  $\times 23$

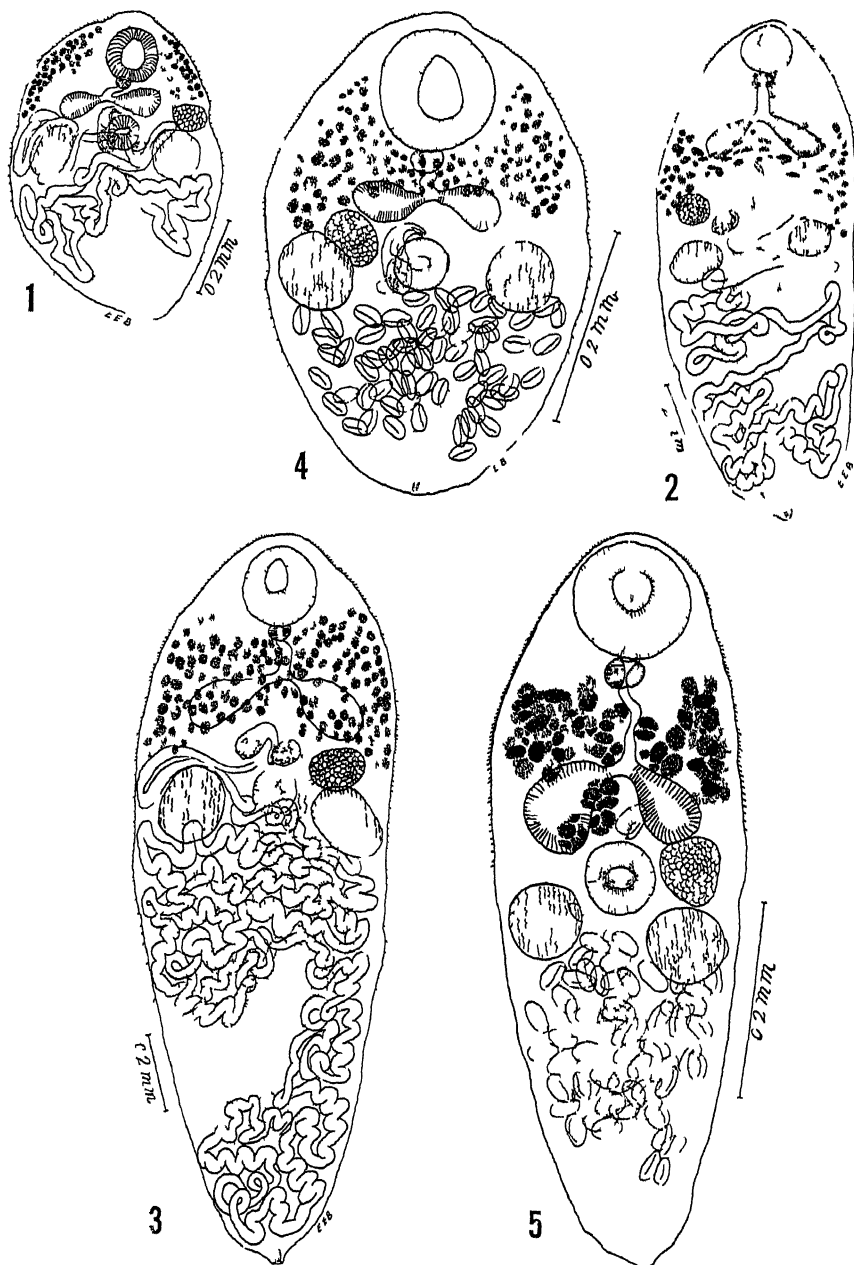
2 3 *B. mesorchium* new species. 2 Dorsal view  $\times 23$  3 details of excretory system outline  $\times 23$

4 *B. georgianum* new species. Ventral view  $\times 23$

5 6 *B. liturum* Holl. 5 Dorsal view of specimen from *Rana sphenoccephala*  $\times 23$  6 details of excretory system outline  $\times 23$  7 details of the ovum complex diagrammatic

(All figures except 3, 6, and 7 were drawn with the aid of the camera lucida.)



1 *Brachycoelium gracile*, new species. Ventral view.  $\times 23$ 2 *B. dorsale*, new species. Dorsal view.  $\times 23$ 3 *B. louisianae*, new species. Dorsal view.  $\times 23$ 4 *B. daviesi* Harwood. Dorsal view of specimen from intestine of *I. elegans* (late stage).  $\times 23$ 5 *B. meridionalis* Harwood. Dorsal view of single specimen (U. S. N. M. H. M. C. 11111-304).  $\times 23$

tions between these specimens and Holl's material should be noted. The body is slightly smaller; the suckers are more nearly equal, their sizes having a ratio of 8:5 rather than 2:1, as in Holl's specimens; acetabulum more cephalic in position; ovary more nearly rounded, slightly smaller; testes slightly larger; vitellaria more extensive. These differences are not deemed distinctive enough for the creation of a new species for the present material. The excretory system (pl. 8, fig. 6) and ovarian complex (pl. 8, fig. 7) are figured in detail for the species in question.

**BRACHYCOELIUM LYNCHI** Ingles, 1936

*Brachycoelium lynchi* was described by Ingles (1936) from the intestine of the frog *Rana aurora*, collected at Mount Shasta City (Siskiyou County), Calif. Ingles states that *B. lynchi* most closely approaches *B. daviesi* in relationship. It is my opinion that the continuous bridge of vitellaria over the dorsal portion of the anterior end of the body in *B. daviesi* is sufficient to separate the two species definitely, since in *B. lynchi* the vitellaria are confined to the lateral fields. The anterior position of the testes definitely separates this species from all my material.

**BRACHYCOELIUM STORERIAE** Harwood, 1932

This species of fluke was described by Harwood (1932) from a single specimen taken from the intestine of DeKay's snake (*Storeria dekayi*) collected from the vicinity of Houston, Tex., and represents the second species of the genus to be described from snakes. I feel that the species must be considered as valid until more material is available for study. None of the specimens in the present collection can be assigned to this species, although eight of the specimens show a close resemblance to it.

**BRACHYCOELIUM DORSALE**, new species

PLATE 9, FIGURE 2

Eight specimens of this species were taken from the intestine of the salamander *Ambystoma opacum*, collected from the vicinity of Pearl River, La. At first sight the flukes appeared to be identical with *B. storeriae*, but on closer examination they were found to represent a new species. The dorsal distribution of the vitellaria suggests the specific designation.

*Description*.—Body elongated, almost cylindrical, with parallel sides and gently rounded ends; 1.28 mm long by 0.49 mm wide. Cuticle thin, armed anteriorly with very delicate spines as far posterior as middle of posttesticular region of body. Oral sucker sub-

terminal, slightly more muscular than acetabulum, transversely oval, 0.15 mm long by 0.16 mm wide. Acetabulum 0.105 mm long by 0.122 mm wide, about one-third body length (0.423 mm) from anterior end. Ratio of sizes of oral sucker and acetabulum, approximately 8:2. Pharynx muscular, transversely oval, 0.033 mm long by 0.068 mm wide, connected with oral sucker by short prepharynx, surrounded by numerous peripharyngeal gland cells. Esophagus slightly longer than transverse diameter of pharynx, surrounded by periesophageal gland cells. Caeca saclike, rather long, 0.17 mm long by 0.074 mm wide, ending well in front of acetabulum, lined internally with rather low epithelial cells. Ovary almost spherical, 0.091 mm long by 0.10 mm wide, alternating from right to left side of acetabulum, usually about on same level as acetabulum. Oviduct delicate, long. Oötype at about level of equatorial plane of acetabulum. Laurer's canal present. Shell gland surrounding oötype. Receptaculum seminis spherical, large. Uterus a simple tube, descending to near posterior margin of body by a series of transverse loops, ascending by similar course to genital pore; loops almost completely crossing body in posttesticular region of body. Ova  $27\mu$  to  $30\mu$  by  $39\mu$  to  $45\mu$ , thick-shelled, operculated, fully embryonated when oviposited. Metratem weakly developed. Vitellaria sparse, follicles spindle-shaped, widely separated, forming a continuous bridge under dorsal surface just posterior to bifurcation of caeca; vitellaria in lateral fields, extending from anterior margin of ovary on one side and anterior margin of testis on other side to level of bifurcation of caeca. Yolk ducts converging near oötype to form small yolk reservoir. Testes transversely oval, behind level of acetabulum, opposite or slightly in tandem, depending on position of ovary for their exact location (when ovary is right, right testis more posterior); right testis 0.109 mm long by 0.141 mm wide; left testis 0.156 mm long by 0.153 mm wide. Vasa efferentia uniting on entering cirrus sac. Cirrus sac club-shaped, usually forming an inverted U just in front of acetabulum, but sometimes lying dorsal or lateral to acetabulum, rarely extending to posterior margin of sucker, containing spherical vesicula seminalis, bulbous pars prostatica with its gland cells, a short ductus, and a weakly developed cirrus. Excretory system identical with that of other members of the genus, with a flame cell pattern of the  $2 \times 6 \times 3$  type.

*Host*.—*Ambystoma opacum* (Gravenhorst).

*Habitat*.—Small intestine.

*Locality*.—Pearl River, La.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 9029.

*Remarks*.—*Brachycoelium dorsale* appears to be more closely related to *B. storeriae* than to any of the other members of the genus. It is separated from this species by the extent and configuration

of the vitellaria, the larger suckers, the larger ovary and testes, and the transverse looping of the uterus. From all other members of the genus thus far mentioned it is separated by the transverse bridge of vitellaria. The position and distribution of the vitellaria, the size and ratio of the suckers, and the uterine pattern serve to separate it from the remaining members of the genus.

BRACHYCOELIUM LOUISIANAE, new species

PLATE 9, FIGURE 3

This species of fluke is represented by five specimens taken from the small intestine of the salamander *Ambystoma opacum*, collected from the vicinity of Pearl River, La.

*Description.*—Body decidedly elongated, spatulated, being broadly rounded anteriorly and somewhat more pointed posteriorly, 2.04 mm to 3.1 mm long by 0.72 mm wide. Cuticle relatively thin, armed with fine spines anteriorly as far as middle of posttesticular portion of body. Oral sucker subterminal, circular, 0.20 mm in diameter. Acetabulum circular, 0.134 mm in diameter, well forward in anterior third of body, 0.496 mm behind anterior body margin. Ratio of sizes of oral sucker and acetabulum, approximately 3:2. Prepharynx present, short. Pharynx muscular, almost globular, 0.052 mm long by 0.069 mm wide. Esophagus nonmuscular, 0.17 mm long. Caeca flask-shaped, 0.29 mm long by 0.125 mm wide, diverging posterolaterad to end well in front of acetabulum, lined internally by a rather heavy epithelium. Ovary transversely oval, 0.128 mm long by 0.149 mm wide, usually left in position (right in one specimen observed), close behind end of caecum and slightly anterior to level of acetabulum. Oviduct long. Oötype at about level of equator of acetabulum. Laurer's canal, a spherical receptaculum seminis, and shell gland present. Uterus a simple tube, greatly convoluted, descending limb forming transverse and oblique loops to near posterior margin of body, ascending limb forming two or three transverse loops in posterior body, then passing forward by short loops on ovarian side to about middle of posttesticular region, here again forming a series of complete transverse loops before passing to genital pore. Metraterm weakly developed. Ova numerous, thick shelled, operculated, fully embryonated when oviposited,  $30\mu$  by  $45\mu$ . Vitellaria follicular, dispersed superficially just under dorsal surface, continuous from side to side, extending from level of anterior margin of ovary to posterior boundary of oral sucker, overlapping entire digestive tract. Yolk ducts converging just posterior to oötype, forming a small crescent-shaped yolk reservoir. Genital pore ventral, in midline just in front of acetabulum. Testes rather large, lateral, opposite acetabulum, testis on side of body opposite ovary

slightly more advanced; right testis closely apposed to ovary when ovary is right, 0.233 mm long by 0.227 mm wide; left testis closely opposed to ovary when ovary is left, 0.251 mm long by 0.240 mm wide. Vasa efferentia uniting on entering cirrus sac. Cirrus sac fairly large, club-shaped, usually entirely in front of acetabulum, sometimes extending laterad or dorsad to sucker, about one-third longer than diameter of acetabulum, containing a spherical vesicula seminalis, a bulbous pars prostatica with its gland cells, a short ductus, and a weakly developed cirrus. Excretory system of same general pattern observed for *B. mesorchium*; flame cell pattern of the  $2 \times 6 \times 3$  type.

*Host*.—*Ambystoma opacum* (Gravenhorst).

*Habitat*.—Small intestine.

*Locality*.—Pearl River, La.

*Type specimen*.—U.S.N.M. Helm. Coll. no. 9027.

*Remarks*.—*Brachycoelium louisianae* shows a closer relationship to *B. storeriae* and *B. dorsale* than to any other member of the genus. The larger body, suckers, ovary, testes, and cirrus sac, and the distribution of the vitellaria, definitely distinguish it as a separate and distinct species.

#### BRACHYCOELIUM DAVIESI Harwood, 1932

##### PLATE 9, FIGURE 4

*Brachycoelium daviesi* was described by Harwood (1932) from the intestine of *Leiolopisma laterale*, *Pseudacris triseriata*, *Hyla cinerea*, and *Ambystoma microstomum*, collected at Houston, Tex. I am able to assign to this species eight specimens from the intestine of the ground skink (*Leiolopisma laterale*) collected at New Orleans, La., and five specimens from the same host collected at Pearl River, La. The material in the present collection shows: A smaller body; an armature of spines that extend to one-third the distance beyond the testes; more uniform suckers, although these structures show a size ratio of 2:1; and a smaller ovary and smaller testes. The excretory system is typically that observed for *B. mesorchium*.

#### SPECIES INQUIRENDA

#### BRACHYCOELIUM MERIDIONALIS Harwood, 1932

##### PLATE 9, FIGURE 5

This species was described by Harwood (1932) from the intestine of the spring lizard (*Triturus meridionalis*) collected from the vicinity of Houston, Tex. Through the courtesy of Dr. Maurice C. Hall, formerly chief of the zoological division, U. S. Bureau of

Animal Industry, I have been privileged to examine paratypes, slide no. 30875, of *B. meridionalis*. The slide carries two specimens of the species, one mounted in lateral view, the other in surface view. Observations on this material force me to the conclusion that there has been some mistake in the designation of paratypes, or that the species in question is to be considered as a synonym of *B. trituri*. In the specimen mounted in surface view, the only one of the specimens suitable for study, there is a decided break in the vitelline follicles just dorsal to the line of the esophagus, separating the glands into two lateral groups (pl. 9, fig. 5). Although these glands spread mesad almost to the midline, the esophagus lies fully exposed in the gap between the two groups. If in the future the same condition is found to be true for the type specimen, I suggest that *B. meridionalis* be suppressed in favor of *B. trituri*.

#### DISCUSSION

With the completion of the present study there are possibly 13 well-defined species belonging to the genus *Brachycoelium* Dujardin, 1845, as follows: *B. crassicolle*, *B. hospitale*, *B. obesum*, *B. trituri*, *B. storeriae*, *B. daviesi*, *B. meridionalis* (?), *B. lynchi*, *B. mesorchium*, *B. georgianum*, *B. ovale*, *B. dorsale*, and *B. louisianae*. The morphological characters of the members of the genus are strikingly similar in every detail except for certain constant variations that seem to warrant the creation of separate species. These variations are most noticeable with respect to the shape and size of the body, the presence or absence (?) of spines and their extent, the ratio of the sucker sizes, the shape and size of the ovary, testes, and eggs, and the distribution and configuration of the vitellaria. In regard to the last-named character there seem to be sufficient variations among the members of the genus to warrant the separation of the genus into two subgeneric groups. The establishment of these two groups is deferred, however, to some future date. It seems sufficient at this time to point out the major differences that tend to separate the species into two groups.

In the first group, containing the species *B. crassicolle*, *B. hospitale*, *B. obesum*, *B. trituri*, *B. lynchi*, *B. mesorchium*, *B. georgianum*, and *B. ovale*, the follicles of the vitellaria lie in the fields lateral to the intestinal tract and are placed in the superficial mesenchyme just under the ventral, lateral, and dorsal surfaces of the body. The species *B. hospitale* and *B. trituri* (?) offer the only exception to this distribution. In *B. hospitale* the vitellaria are described as being found in the mesenchyme lateral to the intestinal tract, but in the mesial plane of the sagittal section, and arranged along a longitudinal vitelline duct. It will be noted from the present study that the vitellaria in the specimens assigned to this species (pl. 8, fig. 1) show a marked tend-

ency to spread mesad and laterad in the areas of their extent. In the other exception, *B. trituri*, the vitellaria are said to be lateral to the intestinal rami, although nothing is said concerning their dorsal or ventral extension. In the figure accompanying the original description of the species, the vitellaria are represented by about seven follicles in each group. Here again (pl. 8, fig. 5) we see a tendency on the part of these glands to be more numerous than was originally figured and to conform more nearly to the pattern as outlined for the group. These two exceptions, when compared to the other members of the group, in no way alter the rule.

In the second group, containing the species *B. storeriae*, *B. daviesi*, *B. meridionalis*, *B. dorsale*, and *B. louisianae*, the follicles of the vitellaria spread from the superficial mesenchyme just under the ventral surface around the lateral margin of the body to the dorsal surface where they become confluent from side to side, thus forming a continuous bridge of follicles across the dorsal surface, overlying all genital structures and the digestive system throughout their extent.

The family Brachycoeliidae contains three well-defined genera, *Brachycoelium* Dujardin, 1845, *Glypthelmins* Stafford, 1905, and *Mesocoelium* Odhner, 1911, which, owing to the similarities of structures, especially of the excretory system, seem to justify their being included in the same family and tend to establish the family as a natural group. The justification of such a classification of these genera can be more definitely determined after the developmental history of the members is known. Faust (1929) placed the family Brachycoeliidae in his superfamily Dicrocoelioidea along with the families Dicrocoeliidae (Looss), Plagiorchidae Lühe, and Lissorchiidae Poche. Later, the same author (1932) added the family Allocreadiidae Stossich to the superfamily group. From a morphological standpoint the superfamily Dicrocoelioidea is based on the type of excretory system exhibited by the various individual family groups and on the similarities in developmental phenomena. The excretory system of the group is characterized by having a median, Y-shaped bladder, the main stem of which is rather long and which gives rise to two longer or shorter cornua anteriorly. The cornua in turn give rise to the common collecting tubules which give rise to the branches that form a basic pattern. The basic flame cell pattern,  $2 [(1+1+1) + (1+1+1)]$ , characteristic for the superfamily group, becomes expanded in various ways to give rise to the definitive pattern found in the separate families. In the family Brachycoeliidae this basic pattern becomes expanded into the definitive pattern of  $2 [(3+3+3) + (3+3+3)]$  and is known for the following members of the family group: *Glypthelmins californiensis* (Cort, 1919), *Mesocoelium sociale* (Lühe, 1901) Sewell, 1920, and members of the

genus *Brachycoelium* as described above. The definitive flame cell pattern is known for all families now included in the superfamily Dicrocoelioidea except for the family Lissorchidae.

The members of the genus *Brachycoelium* show a marked uniformity in the characteristics of the definitive flame cell pattern. The main variation noted for the system is in the irregularity of the anterior end of the bladder stem. This end of the bladder may be observed to end blindly as a knoblike projection beyond the origins of the two common collecting tubules, or it may become somewhat broadened and slightly notched so as to resemble the flame of an oil lamp, at which times the common collecting tubules are given off from the anterolateral angles of the bladder, or again it may form short, bluntly rounded cornua, the tips of which give rise to the common collecting tubules. It is probable that these variations in the bladder stem are best explained by assuming that the bladder in *Brachycoelium* is derived from the I-shaped bladder and that the anterior end of this is more elastic and allows for considerable expansion. These variations in the stem of the bladder are of minor significance as compared with the influence of the fundamental plan of the excretory system.

#### KEY TO THE SPECIES OF THE GENUS BRACHYCOELIUM

1. Vitellaria in two groups, lateral to intestinal tract..... 2  
    Vitellaria continuous from side to side in dorsal position, overlapping intestinal tract..... 9
2. Body averaging 1 mm or less in length..... 3  
    Body averaging more than 1 mm in length..... 4
3. Testes anterior to ovary..... lynchi  
    Testes posterior to ovary..... ovale
4. Body averaging 4 mm long by 1.2 mm wide; European..... crassicolle  
    Body averaging less than 4 mm long; American..... 5
5. Vitellaria mediolateral, follicles united by a longitudinal vitelline duct; worm 2.25 mm long; ratio of sucker sizes, 4:3..... hospitale  
    Vitellaria superficially placed, under ventral, lateral, or dorsal surface of body..... 6
6. Vitelline follicles few in number, dorsally placed; worm 1 mm to 1.4 mm long; ratio of sucker sizes, 2:1 to 8:5..... trituri  
    Vitelline follicles numerous, ventrally, laterally, and dorsally placed..... 7
7. Testes transversely oval, medially placed, their inner margins overlapping midline; worm 1.7 mm long; ratio of sucker sizes, 7:5..... mesorchium  
    Testes elongated oval, lateral in position..... 8
8. Testes large (more than 0.22 mm long); worm 1.3 mm long; ratio of sucker sizes, 2:1..... georgianium  
    Testes less than 0.22 mm long; worm 0.75 to 1.4 mm long; ratio of sucker sizes, 5:3..... obesum



9. Body more than 1 mm long----- 10  
 Body less than 1 mm long----- 12
10. Testes more than 0.20 mm in greatest diameter; body more  
 than 2 mm long; ratio of sucker sizes, 3:2----- louisianae  
 Testes less than 0.20 mm in greatest diameter----- 11
11. Testes more than 0.10 mm in greatest diameter; body 1.2 mm  
 long; ovary 0.1 mm in greatest diameter; vitelline follicles  
 spindle-shaped, sparse; ratio of sucker sizes, 3:2----- dorsale  
 Testes less than 0.10 mm in greatest diameter; body 1.2 mm  
 long; ovary less than 0.1 mm in diameter; vitelline follicles  
 numerous; ratio of sucker sizes, 3:2----- storeriae
12. Body 0.85 mm to 0.95 mm long; ovary 0.076 mm by 0.084 mm;  
 testes more than 0.1 mm in diameter; ratio of sucker sizes,  
 3: 2----- (?) meridionalis  
 Body 0.50 mm to 0.95 mm long; ovary 0.1 mm or more in  
 diameter; testes less than 0.1 mm in diameter; ratio of  
 sucker sizes, 2: 1----- daviesi

## LITERATURE CITED

- BRAUN, MAX, and LÜHE, MAX.  
1910. A handbook of practical parasitology, 208 pp., 100 figs. London.
- BYRD, ELON E.  
1935. Life history studies on Reniferinae (Trematoda, Digenea) parasitic in Reptilia of the New Orleans area. Trans. Amer. Micr. Soc., vol. 54, no. 3, pp. 196-225, 1 fig., 5 pls.
- DUJARDIN, FÉLIX.  
1845. Histoire naturelle des helminthes ou vers intestinaux, 654 pp., 12 pls. Paris.
- FAUST, ERNEST CARROLL.  
1919. The excretory system in Digenea. Biol. Bull., vol. 36, pp. 315-344, 17 figs.  
1929. The trematodes or flukes. Classification. Chapter 9 in "Human Helminthology", pp. 83-98. Philadelphia.  
1932. The excretory system as a method of classification of digenetic trematodes. Quart. Rev. Biol., vol. 7, no. 4, pp. 458-468, 22 figs.
- HARWOOD, PAUL DUANE.  
1932. The helminths parasitic in the Amphibia and Reptilia of Houston, Texas, and vicinity. Proc. U. S. Nat. Mus., vol. 81, art. 17, 71 pp., 5 pls.
- HOLL, FREDERICK JOHN.  
1928. New trematodes from the newt *Triturus viridescens*. Journ. Helm., vol. 6, no. 3, pp. 175-182, 9 figs.
- HOPKINS, SEWELL HEPBURN.  
1934. The papillöse Alloeacardiidae. Illinois Biol. Monogr., vol. 13, no. 2, 80 pp., 6 figs., 4 pls.
- INGLES, LLOYD GLENN.  
1936. Worm parasites of California Amphibia. Trans. Amer. Micr. Soc., vol. 55, no. 1, pp. 73-92, 3 pls.
- JOHNSTON, S. J.  
1912. On some trematode parasites of Australian frogs. Proc. Linn. Soc. New South Wales, vol. 37, pt. 2, pp. 285-362, 30 pls.
- LOOSS, ARTHUR.  
1899. Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens, zugleich Versuch einer natürlichen Gliederung des Genus *Distomum* Retzius. Zool. Jahrb. (Abt. Syst.), vol. 12, pp. 521-784, 1 fig., 9 pls.
- NICOLL, WILLIAM.  
1914. Trematode parasites from animals dying in the Zoological Society's Gardens during 1911-1912. Proc. Zool. Soc. London, 1914, pp. 139-154, 4 pls.
- RUDOLPHI, CARL ASMUND.  
1809. Entozoorum sive vermium intestinalium historia naturalis, vol. 2, pt. 1, 457 pp., 6 pls. Amsterdam.
- STAFFORD, JOSEPH.  
1900. Some undescribed trematodes. Zool. Jahrb. (Abt. Syst.), vol. 13, pp. 399-414, 1 pl.  
1903. Two distomes from Canadian Urodela. Centralbl. für Bakt., Parasit. und Infekt. (Orig.), vol. 34, pp. 822-830, 1 pl.  
1905. Trematodes from Canadian vertebrates. Zool. Anz., vol. 28, pp. 681-694.



# PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM



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## NEW MUSCOID FLIES (DIPTERA) IN THE UNITED STATES NATIONAL MUSEUM

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INCLUDED among the species of muscoid flies described in this paper are certain forms that are of considerable interest because of their unusual host relationships or their economic importance. Names for these have been requested in connection with investigations being conducted on their biology or control.

### Genus **HYLEMYA** Robineau-Desvoidy

#### **HYLEMYA ABDENA**, new species

#### FIGURE 19

*Male*.—Head with front narrower than breadth of anterior ocellus and but faintly discernible except anteriorly; frontal bristles about eight, only three of these strong; parafrontals and parafacials thinly silvery gray pollinose; antenna black, third segment slightly longer than second; arista pubescent; bucca narrow, black-haired; palpus and proboscis black, both ordinary.

Thorax densely yellowish gray pollinose, opaque, striping hardly discernible; anterior acrostichal bristles three, the median pair strong; anterior dorsocentral bristles two, strong; humeral bristles two; sublateral bristles two; preapical bristles two, the anterior of which are at least half as long as the posterior; posterior dorsocentral

bristles three; propleura, mesopleura, and pteropleura bare; sternopleural bristles three, the median bristle just below and slightly anterior to the hindmost bristle; scutellum with two long marginal bristles, the apical bristles longer.

Abdomen gray pollinose, with a narrow mid-dorsal black stripe and with abundant erect hairs; sternites laterally with longer hairs in series; hypopygium (fig. 19) of moderate size, black, internal morphological features as illustrated.

Wing hyaline; costal spine present; upper squama longer than lower, rounded, whitish, yellow on rim; veins 3 and 4 slightly divergent at apex; outer cross vein almost straight.

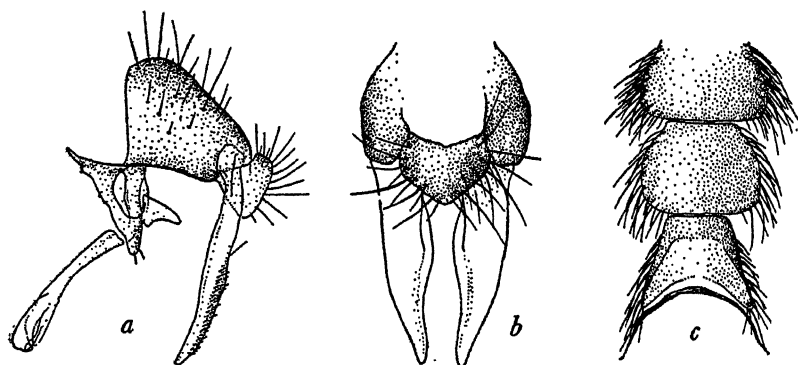


FIGURE 19.—*Hylemya abdona*, new species: a, Left lateral view of male terminalia; b, rear view of male forceps; c, sternites of male.

Legs black; anterior femur with complete posterior and anterior dorsal rows of bristles, a scattered series of setalike hairs posteriorly which are not in rows, and a series of bristles basally on the posterior ventral surface; anterior tibia with one long subapical dorsal bristle and a shorter bristle near apical third, two posterior ventral bristles, the first near the middle, the second curved and sharp, situated almost apically; anterior basal tarsal segment with a short basal ventral fringe, the first bristle the longest; middle femur with a short basal row of four long ventral bristles, one anterior ventral bristle near the basal third, an apical posterior dorsal series of three bristles, a complete row of shorter anterior bristles; middle tibia with one posterior dorsal bristle, one anterior dorsal and two posterior ventral bristles; hind coxa without hair posteriorly; hind femur with two apical dorsal bristles, a complete row of bristles posteriorly which are scattered basally, one long and strong subapical posterior bristle, a short apical anterior dorsal row of bristles, a short apical row of about three bristles posterodorsally, a complete row anteriorly, a short apical row anteroventrally, and one fairly long ventral bristle near the base; hind tibia with three posterior dorsal bristles,

the first at the basal fourth, the second at the basal third, and the last at the apical fourth, with one dorsal subapical bristle, four anterior dorsal bristles in a widely spaced row, two anterior ventral bristles, the first near the middle, the second near the apical fourth, and four bristles in a short row near the middle posteriorly.

*Female*.—Like male except for normal sexual differences.

*Type locality*.—Portland, Oreg.

*Type and paratypes*.—U.S.N.M. no. 51695.

*Host plant*.—Carnation.

*Remarks*.—Described from a type (male) and a series of 23 paratype male and female specimens reared during the summer of 1936 as an economic pest of carnation by Charles Doucette at Portland, Oreg.

The species described above differs from *Hylemya trichodaetyla* Rondani (of which *Hylemya floreliga* Zetterstedt is a synonym) in that the fore tibial spur is sharp, not blunt; the hind femur does not have posterior ventral bristles on the apical half; the middle metatarsus is not setulose above; and the hind tibia does not have a row of posterior ventral setulose hairs. It differs from *Hylemya planipalpus* Stein (which is a valid species and not a synonym of *Hylemya floreliga* Zetterstedt) in the presence of a well-developed anterior ventral bristle near the basal third and in the absence of a posterior ventral series of setulose hairs on the hind tibia. *Hylemya abdona* differs from other species in the genus in the male genitalia and in combinations of chaetotaxal characters.

#### Genus ZENILLIA Robineau-Desvoidy

ZENILLIA (SISYROPA) NOX, new species

#### FIGURE 20

*Male*.—Head (fig. 20, *a*) with front produced anteriorly, approximately one-third width of one eye; antennal axis to vibrissal axis as 7 is to 5; frontal stripe dark brown and as wide above as one parafacial; ocellar bristles distinct and proclinate; outer vertical, postvertical, and vertical bristles present; outer orbital bristles absent; frontal bristles about 12, the rows diverging widely below to nearly the apex of the second antennal segment; parafrontals gray pollinose and with numerous scattered black setalike hairs; parafacials silvery gray pollinose, bare, facial ridges bare; antenna black, third segment three times as long as second and reaching three-fifths the distance to the vibrissae, which are well developed and at the oral margin; antennal bases hardly separated; arista with microscopic pubescence on basal fourth, thickened, penultimate segment not longer than wide; clypeus moderately deep; a slight carina pres-

ent; epistoma sunken; bucca one-sixth eye height, with black hair; eye large, covered with tawny hair; back of head with two rows of

postocular ciliae, the middle and below with pale tawny hairs; palpus and proboscis black, ordinary.

Thorax black, thinly gray pollinose; anterior acrostichal bristles three; anterior dorsocentral bristles three; sublateral bristles two; the presutural sublateral long and well defined; humeral bristles five; posthumeral bristles two; propleura bare; sternopleural bristles three, the mid bristle below and slightly posterior to the foremost; prosternum with a tuft of setalike hairs on lateral margins; postsutural acrostichal bristles three; posterior dorsocentral bristles four; prealar bristles three; scutellum with three marginal bristles, one subapical, and one apical bristle.

Abdomen subconical, black, with thin yellowish gray pollinosity; first segment black, remaining segments mid-dorsally and posteriorly shining black; first and second segments with

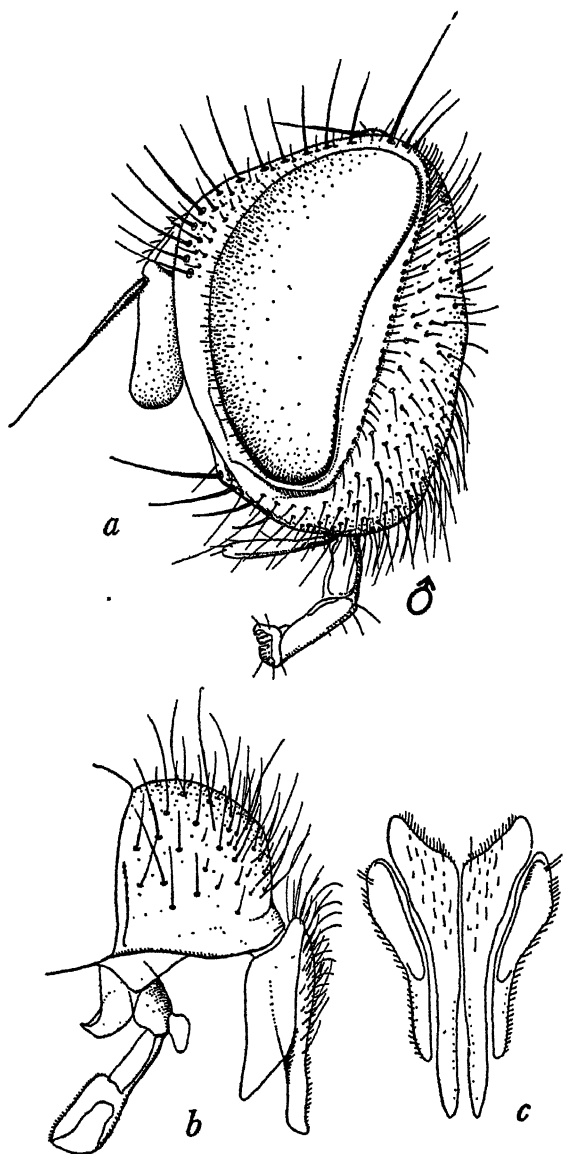


FIGURE 20.—*Zenillia (Sisyropa) now*, new species: *a*, Left lateral view of male head; *b*, left lateral view of male terminalia; *c*, rear view of male forceps.

well defined median marginal bristles; third and fourth segments with rows of marginal bristles; all segments except first with median

discal bristles not definitely arranged in pairs; fourth segment with numerous scattered discal bristles; hypopygium (fig. 20, *b* and *c*) small, black, almost concealed.

Wing hyaline; epaulet black; costal spine absent; third costal section equal to fifth in length; third vein with two or three basal setulae both above and below; apical cell open; fourth vein ending slightly before wing apex and with a distinct angulated bend; squama infuscated, yellowish or orange white, darker on rim.

Legs black; anterior femur with complete dorsal, posterior dorsal, and posterior ventral rows of bristles and posteriorly with long scattered setalike hairs which are not in rows; anterior tibia with a staggered dorsal row of bristles, and with two posterior bristles on the apical third; claw and pulvillus fully one and one-half times as long as apical tarsal segment; middle femur with staggered anterior basal bristles which are not in rows, a row of anterior ventral bristles on the apical third, three long bristles on the anterior ventral basal third, a complete posterior ventral row of bristles which are longest basally, the apical posterior with a series of bristles; middle tibia with one ventral bristle near middle, one elongate bristle on the anterior ventral surface near middle, two posterior dorsal bristles, the first near middle and the second near apical fourth; hind coxa bare behind; hind femur with three or four long basal posterior ventral bristles, anteroventrally with two long bristles basally and two long bristles apically, a complete anterior dorsal row, a basal anterior row; hind tibia with a row of posterior dorsal bristles, the two at middle of row longer and stronger, a series of three anterior ventral bristles near the apical third, and a complete row of anterior dorsal bristles which may be considered ciliate, the row with one or two longer and stronger bristles near middle.

*Female*.—Front approximately 0.31 of head width; outer orbital bristles two, proclinate; thorax more heavily pollinose than in male; abdomen with the terminal segment closing slitlike below and with the lateral margins heavily setose; legs as in male.

*Type locality*.—Hokkaido, Japan.

*Type and paratypes*.—U.S.N.M. no. 51693.

*Host*.—*Nematus erichsoni* Hartig.

*Remarks*.—Described from a type (male) and a series of 119 male and female paratype specimens reared as a parasite of the larch sawfly by Shizuai during the spring of 1936.

#### Genus MYOCERA Robineau-Desvoidy

1830. *Myocera* ROBINEAU-DESVOIDY, Essai sur les Myodaires, Mém. Prés. Acad. France, vol. 2, p. 328.

1863. *Myocera* ROBINEAU-DESVOIDY, Histoire naturelle des diptères des environs de Paris, vol. 2, pp. 392-393.



In the first reference above, Robineau-Desvoidy described four genera, *Phorostoma* (p. 326), *Myostoma* (p. 327), *Billaea* (p. 328), and *Myocera* (p. 328). In his 1863 paper he stated that the genotypes of the first and last named were specifically identical. He said that his male of *subrotunda*, sole species of *Phorostoma*, and his *longipes* female, first-named species of *Myocera*, were synonyms of *ferina* Fallen. In the original descriptions, *Phorostoma*, *Myostoma*, and *Billaea* are said to be much alike, differing mainly in the position and shape of the antennae. *Myocera* is said to be analogous to the other three in the original description, and the apical cell is said to be open in the apex of the wing.

In the latter work it becomes obvious that *Phorostoma* and *Myocera* are alike, and the supposition can only be that all four are essentially similar.

MYOCERA TABANIVORA, new species<sup>1</sup>

FIGURE 21

*Male*.—Head with front very narrow, about 0.011 of head width in the single specimen; frontal stripe dark, less than one parafrontal in width at narrowest point just below ocelli, but widening gradually to fully four times this width anteriorly; parafrontals black with thin gray pollinosity; frontal bristles about eight, the rows diverging but slightly below and descending to about the base of second antennal segment; a few short bristlelike hairs situated between the frontals; parafacials bare, golden pollinose over the black ground color; facial ridges without ascending bristles; antennae black, third segment about one and one-half times the length of second, descending only to about the lower third of clypeus; arista short, about as long as second and third antennal segments together, yellowish at middle, short-plumose both above and below to tip, penultimate segment short; a well-developed facial carina descending to lower third of clypeus; vibrissae above the oral margin by about the length of the second antennal segment; epistoma protuberant; epistomal and antennal axes approximately equal; bucca about one-fourth eye height, with black hair; palpus elongate, slender, rather yellowish; proboscis hardly longer than buccal length; eye bare, oblique; back of head with one and a partial second row of postocular ciliae, the middle and below with black hairs, below with some hair; ocellar bristles proclinate, well defined; outer orbital bristles absent; vertical bristles distinct; outer vertical bristles not differentiated from surrounding setae.

Thorax black with dorsal stripes poorly differentiated by slight silvery pollinosity; humeral bristles four; postlateral bristles present in foremost only; anterior dorsocentrals four; anterior acrostichals

<sup>1</sup> A description of the pupa of this species by C. T. Greene follows on page 217.

absent; posterior dorsocentrals four; prescutellar bristles one; sternopleurals three, in a triangle, the middle one but slightly posterior to foremost; prosternum bare; postalar declivity bare; intrasquamal setulae absent; propleura with several long bristlelike hairs at its middle; scutellum with numerous hairlike setae, with three marginal bristles, apical bristles about as long as lateral and subapical bristles small.

Abdomen black, thinly grayish pollinose, tessellated; dorsally without defined marginal bristles but with numerous hairlike setae; fourth segment mostly red, basally the dorsum a little darkened; ventrally all sternites overlapped by tergites; hypopygium red, morphological features (fig. 21) as illustrated.

Wing normal, hyaline; a few basal setulae on third vein; bend of fourth vein with a rounded angle; apical cell plainly open near apex of wing; third costal section about as long as fifth and sixth together.

Legs black; fore tibia with two posterior bristles at middle and with a row of anterior dorsal

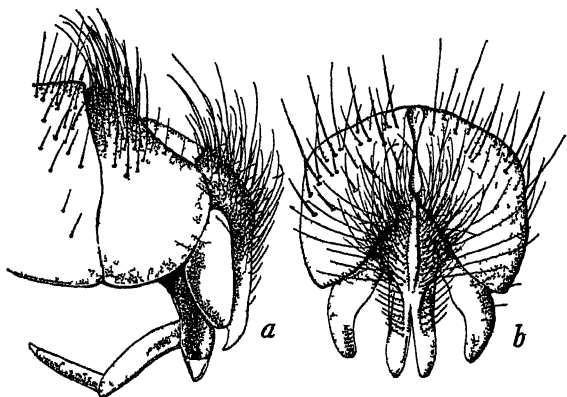


FIGURE 21—*Myocera tabanivora*, new species *a*, Left lateral view of male terminalia; *b*, real view of male terminalia

bristles; middle tibia at middle with two anterior dorsal and two posterior bristles, hind tibia not ciliated, with two anterior ventral, three or four anterior dorsal, and three posterior dorsal bristles.

*Type locality*.—Ramsey County, Minn.

*Type*.—U.S.N.M. no. 51694.

*Host*.—Tabanid larva.

*Remarks*.—Described from the single holotype male specimen reared on May 3, 1926, by Dr. C. B. Philip.

Dipterous parasitism of tabanid larvae seems to be of rare occurrence. The records of the United States National Museum show that there are but two such reported instances. An adult of the common widespread bombyliid *Anthrax lateralis* Say was reared from the larva of *Tabanus annulatus* Say, a horsefly that ranges over much of the South Central States, and an adult of *Phasiops flava* Coquillett, a tachinid about which little is known, was reared from the larva of *Tabanus trimaculatus* Beauvais, which has a range similar to that of the horsefly mentioned above. These two records are by Jones and

Bradley,<sup>2</sup> who reared the material during the summer of 1922 at Magnolia, La.

Genus *SARCOPHAGA* Meigen

*SARCOPHAGA DENTIFERA*, new species

FIGURE 22

*Male*.—Head with front 0.214 of head width, average of two specimens (0.221, 0.207); parafrontals and parafacials golden pollinose, the latter with a row of minute bristles below near eye; frontal bristles about nine in number, the rows gradually diverging below to about the middle of the second antennal segment; orbital bristles absent; outer vertical bristles absent; antenna black, third segment two and one-half times the length of second and reaching three-fifths the distance to the vibrissae, which are normal and at the oral margin; arista with long plumosity for three-fifths its length; palpus and proboscis black; bucca three-fifths eye height, with only black hairs before the metacephalic suture; back of head with two rows of postocular ciliae, the middle and below with light hairs.

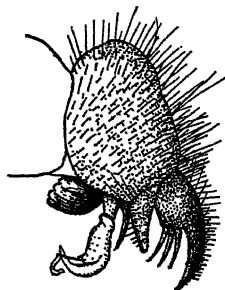


FIGURE 22.—*Sarcophaga dentifera*, new species: Left lateral view of male terminalia.

Thorax gray and golden pollinose with the normal three to five black stripes; pleura with some golden pollinosity; anterior acrostichal bristles three or four; posterior dorsocentral bristles four; sternopleural bristles three; prescutellar bristles one; scutellum with three marginal bristles, one preapical bristle, and one apical bristle.

Abdomen tessellated and with three shifting black stripes, rather bluish metallic in certain lights; median marginal bristles on the third segment; fourth segment with a marginal row of about 12 bristles.

Hypopygium with the first segment black, covered with abundant black hairs and without a marginal row of bristles; second segment red, with black hairs. Genital features as illustrated (fig. 22).

Wing smoky; costal spine absent; third costal section as long as fifth and sixth together; first vein bare; third vein with several basal setulae.

Legs black; middle femur with comb; middle tibia with one anterior dorsal bristle; hind tibia with some long hairs.

*Female*.—Unknown.

*Type locality*.—Iguazu, Argentina.

*Type and paratype*.—U.S.N.M. no. 51690.

<sup>2</sup> Journ. Econ. Ent., vol. 16, p. 312, 1923.

*Remarks.*—Described from the type and one male paratype specimen collected October 4, 1927, by R. C. Shannon.

In addition to the Argentine specimens described above, I have several Brazilian specimens collected by Dr. S. W. Williston at Chapada (two males from the American Museum of Natural History, and one male from the Aldrich collection now in the United States National Museum), which differ from the Argentine specimens in that they are not bluish metallic on the abdomen. The male genitalia appear to be identical throughout the series, as are also the chaetotaxy and other characters so far as I am able to ascertain.

**SARCOPHAGA TRIDENTATA, new species**

FIGURE 23

*Male.*—Head with front 0.176 of head width; parafrontals and parafacials yellow pollinose, the latter with the usual row of minute bristles below near eye; frontal bristles about 11 in number, the rows diverging below to about the middle of the second antennal segment; orbital bristles absent; outer vertical bristles absent; antenna black, third segment two and one-half times as long as second and reaching three-fifths the distance to the vibrissae, which are normal and at the oral margin; arista with long plumosity for over half its length; palpus and proboscis black, both ordinary; bucca one-fourth the eye height, with intermixed black and pale hair before the metacephalic suture; back of head with three rows of postocular ciliae, the middle and below with some pale hair.

Thorax gray pollinose, with the normal three to five black stripes; anterior acrostichal bristles absent; posterior dorsocentral bristles four; sternopleural bristles three; prescutellar bristles one; scutellum with three marginal bristles, one preapical bristle, and one apical bristle.

Abdomen gray tessellated and with three shifting black stripes; median marginal bristles on the third segment; fourth segment reddish with a marginal row of about 16 bristles.

Hypopygium rather small, dark reddish, almost black; both segments somewhat pollinose and covered with numerous black hairs. Genital features as illustrated (fig. 23).

Wing hyaline; costal spine absent; third costal section as long as fifth and sixth together; first vein bare; third vein with several basal setulae.

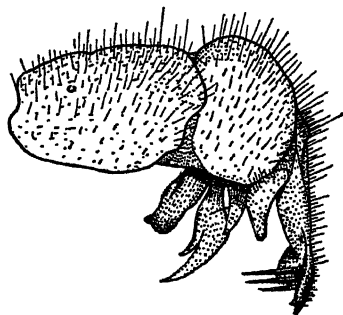


FIGURE 23.—*Sarcophaga tridentata*, new species: Left lateral view of male terminalia.

Legs black; middle tibia with one anterior dorsal bristle and with some long hairs; hind tibia without long hairs.

*Female*.—Unknown.

*Type locality*.—Obrilony, Brazil.

*Type*.—U.S.N.M. no. 51692.

*Remarks*.—Described from the holotype male specimen collected in January (year and collector unknown).

**SARCOPHAGA MINUTIPENIS, new species**

FIGURE 24

*Male*.—Head with front 0.277 of head width; parafrontals and parafacials bright golden pollinose, the latter with scattered minute bristles below near eye; frontal bristles about eight in number, the rows diverging below to about the middle of the second antennal segment; orbital bristles absent; outer vertical bristles absent; antenna black, third segment three times as long as second, reaching four-fifths the distance to the vibrissae, which are normal and at the oral margin; arista plumose for almost its entire length; palpus

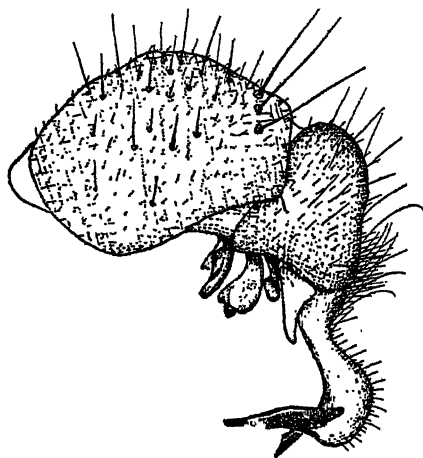


FIGURE 24.—*Sarcophaga minutipenis*, new species: Left lateral view of male terminalia.

and proboscis black, both ordinary; bucca one-fourth the eye height, with intermixed black and pale hair before the metacephalic suture; back of head with two and a partial third row of postocular ciliae, the middle and below with pale hairs.

Thorax gray pollinose, with the normal three to five black stripes; anterior acrostichal bristles absent; posterior dorso-central bristles four; sternopleural bristles three; prescutellar bristles one; scutellum with two marginal bristles, no preapical bristles, and one apical bristle.

Abdomen tessellated and with three shifting black stripes; median marginal bristles on the third segment; fourth segment reddish with a marginal row of about 12 bristles.

Hypopygium yellow, first segment pollinose, with a submarginal row of six bristles; second segment pollinose, rather flat and truncated behind. Genital features as illustrated (fig. 24).

Wing hyaline; costal spine absent; third costal section about as long as fifth; first vein bare; third vein with several basal setulae.

Legs black; middle femur with comb; middle tibia with one anterior dorsal setula; hind tibia without long hairs.

*Female*.—Unknown.

*Type locality*.—Chapada, Brazil.

*Type*.—U.S.N.M. no. 51691.

*Remarks*.—Described from the holotype male specimen collected by S. W. Williston.

**SARCOPHAGA ABNORMALIS, new species**

FIGURE 25

*Male*.—Head with front 0.21 of head width; parafrontals and parafacials golden pollinose, the latter with the usual row of minute setulae below near eye; frontal bristles about eight in number, the rows diverging below and descending to about the middle of the second antennal segment; orbital bristles absent; outer vertical bristles absent; antenna black, third segment three and one-half

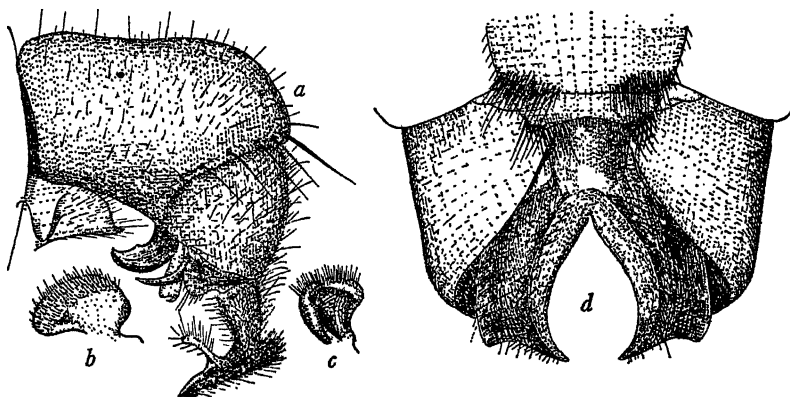


FIGURE 25.—*Sarcophaga abnormalis*, new species: *a*, Left lateral view of male terminalia; *b* and *c*, two views from different angles of accessory plate; *d*, fourth and fifth male sternites.

times the length of second, reaching four-fifths the distance to the vibrissae, which are normal and at the oral margin; facial ridges with ascending setulae; arista with long plumosity for three-fifths its length; palpus and proboscis black, both ordinary; buccal height about one-fourth eye height; with black hairs before the metacephalic suture; back of head with three rows of postocular ciliae, the middle and below with pale hairs.

Thorax gray and golden pollinose, with the normal three to five black stripes; pleurae with some golden pollinosity; anterior acrostichal bristles absent; posterior dorsocentral bristles four; sternopleural bristles three; prescutellar bristles one. Scutellum with two marginal bristles, one preapical bristle, and one apical bristle.

Abdomen tessellated with three shifting black stripes; median marginal bristles on the third segment; fourth segment reddish, with golden spots, and with a marginal row of about 10 bristles; venter of abdomen densely hairy; fourth sternite with posterior margin armed with a distinct brush of short stiff bristles; fifth sternite (fig. 25, *d*) reddish, hairy, divided U-shaped, the arms diverging, and these turning toward each other with a sharp spur.

Hypopygium reddish, first segment anteriorly rather small, then bulging out to about half again its original size, armed along its hind margin with 10 bristles and two subdiscal bristles, bulge pollinose, as is the second segment, which is relatively small in contrast to the preceding one; genital features as illustrated (fig. 25).

Wing subhyaline; costal spine absent; third costal section almost as long as fifth and sixth together; first vein bare; third vein with several basal setulae.

Legs black; middle femur with comb; middle tibia with one anterior dorsal bristle and with some long villosity; hind tibia with long hairs.

*Female*.—Like male except for normal sexual differences.

*Type locality*.—Colombia, South America.

*Type and paratypes*.—U.S.N.M. no. 51689.

*Remarks*.—Described from one male holotype and one female paratype specimen collected in 1928 by John Glass; and one male paratype collected on June 7 at Bartica, British Guiana (American Museum of Natural History).

#### SARCOPHAGA PAULINA, new species

*Male*.—Head with front 0.207 of head width (average of two specimens, 0.206 and 0.208); parafrontals and parafacials deep brown pollinose, the former with the usual row of parafacial hairs below near eye, the lower few hairs long; frontal bristles about nine, the rows diverging below to about the middle of the second antennal segment; antenna black, third segment over twice as long as second, reaching three-fourths the distance to the vibrissae, which are normal and at the oral margin; arista plumose for about half its length; palpus and proboscis black, ordinary; bucca one-third eye height; back of head with three rows of postocular ciliae, a few pale hairs below, none pale below the metacephalic suture.

Thorax with the usual three to five black stripes; anterior acrostichal bristles absent; presutural bristles present and well developed; postsutural dorsocentral bristles three; sternopleural bristles three; scutellum with two marginal bristles, one subapical bristle, and one apical bristle.

Abdomen with the usual black and silvery tessellation; first and second segments with lateral bristles only; third segment with

median marginal bristles; fourth with a marginal row of about 14 bristles; fifth sternite divided, rather brownish, and with long black hair along the inner edges.

Hypopygium black; first segment distinctly pollinose, and with scattered black hair; second segment black, rather shining; forceps black, slightly curved anteriorly and with a distinct tooth at about the middle of the blunt tip; accessory plate somewhat reddish, quite long and pointing anteriorly; posterior clasper black, short, curved slightly anteriorly and with a blunt tip; anterior clasper long, black, curved strongly forward; penis with the first segment semitransparent white, short, slightly curved anteriorly and covered with very minute short white spines; second segment mostly black, its tip sharply pointed anteriorly and terminating in a sharp point, a small tube projecting downward, anteriorly with a pair of small black hooklike plates.

Wing hyaline; costal spine absent; third costal section as long as fifth; first vein bare; third vein with a few scattered setulae.

Legs black; middle femur with comb; middle tibia with two anterior dorsal bristles; hind tibia with long scattered hairs.

*Type locality*.—Miami County, Ohio.

*Type and paratype*.—U.S.N.M. no. 51687.

*Remarks*.—Described from the holotype male collected on June 14, 1928, and one paratype male collected in Lucas County, Ohio, June 19, 1928, by David G. Hall.

This species differs mainly from its closest relative, *Sarcophaga morosa* Aldrich, in the shape of the accessory plate, which in *S. morosa* is triangular, the angles approximately equal. In *S. paulina* the anterior angle is distinctly larger than the opposite angle, causing the free angle to point anteriorly, not directly downward as in *S. morosa*.

#### SARCOPHAGA DAMPFI, new species

##### FIGURE 26

*Male*.—Head with front 0.188 of head width, average of five specimens (0.181, 0.200, 0.192, 0.186, 0.184); parafrontals and parafacials silvery pollinose, the latter with the usual minute bristles below near eye; frontal bristles about 12 in number, the rows diverging below to about the middle of the second antennal segment; orbital bristles absent; outer vertical bristles absent; antenna black, second segment rather yellow; third segment three times as long as the second and reaching almost to the vibrissae, which are normal and at the oral margin; arista with medium-length plumosity for fully three-fifths its length; palpus and proboscis black, both ordinary; bucca about one-fourth the eye height, with black hair; back of head with three rows of postocular ciliae, the middle and below with black hair.



Thorax gray pollinose, with the normal longitudinal stripes; anterior acrostichal bristles somewhat larger than adjacent hairs; anterior dorsocentral bristles two; posterior dorsocentral bristles three; prescutellar bristle one; sternopleural bristles three, in line. Scutellum with two marginal bristles, one apical bristle, and one preapical bristle.

Abdomen tessellated and with three shifting black stripes; only third segment with medium marginal bristles, fourth with a marginal row of about 12 bristles, the segment reddish with golden pollen.

Hypopygium yellowish orange, rather large; first segment with a marginal row of about six well-developed setae; second segment with

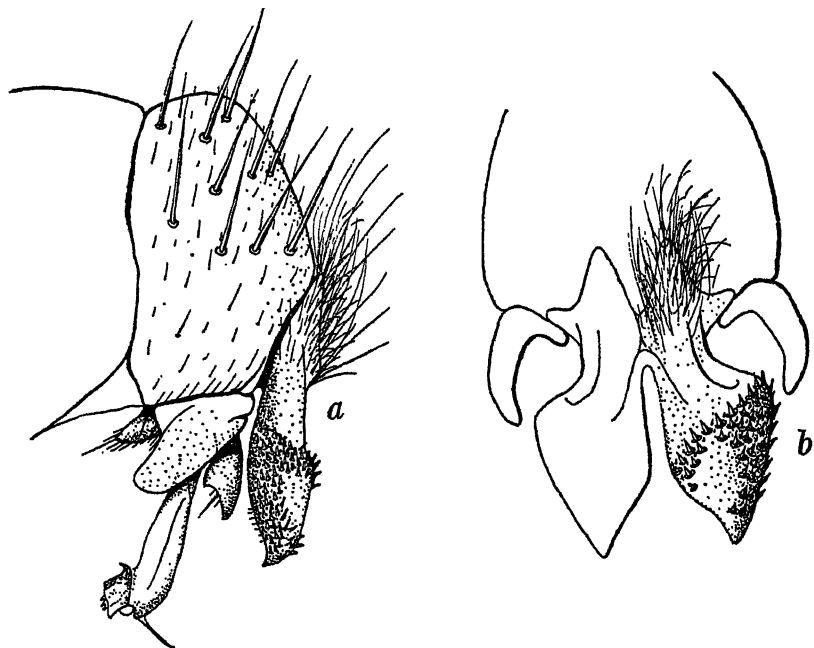


FIGURE 26.—*Sarcophaga dampfi*, new species: *a*, Left lateral view of male terminalia; *b*, rear view of male forceps.

numerous hairs and with scattered elongate setae; fifth sternite divided, heavily chitinized, the posterior lateral margins with close-set short thick spine; below the accessory plate anteriorly, a small knob-like structure, evidently fused with the plate and covered with thick-set hair or hairlike setae; anterior claspers setose at tips; posterior claspers with one short thick seta at the middle of the excavation on the anterior edge, and a smaller seta on each side of it. Internal features as illustrated (fig. 26).

Wing hyaline; costal spine not developed; third costal segment not so long as fifth; first vein bare; third vein with several basal setulae.

Legs black; middle femur with comb; middle tibia with one anterior dorsal bristle; hind tibia without long hairs.

*Type locality*.—La Barca, Jalisco, Mexico.

*Type and paratypes*.—U.S.N.M. no. 51688.

*Remarks*.—Described from the holotype male and three paratype male specimens collected in fruit-fly traps on October 3 and 4, 1934, by Dr. Alfons Dampf, for whom the species is named.

The species belongs to a large group of sarcophagine flies that are parasitic upon other insects. The group is limited to North America and South America and is usually found most prevalent in plain or grassland country.

#### Genus PHAONIA Robineau-Desvoidy

##### PHAONIA PUDOA, new species

*Male*.—Head with front very narrow, frontal bristles about 12, the rows descending below to about base of antennae; parafrontals and parafacials thinly silvery pollinose, the latter bare; antenna black, third segment hardly twice the length of second; arista with short plumosity for its full length; vibrissal axis slightly less in length than antennal axis; bucca about one-fifth eye height, black haired, the hair on upper edge of lower margin curved upward; eyes with long sparse tawny hairs; palpus and proboscis black, ordinary.

Thorax black with thin gray pollen and with the normal four indistinct black stripes; propleura and pteropleura bare; mesopleura with some erect hairs anterior to spiracle; anterior acrostichals two, slight; anterior dorsocentrals two; prescutellars present; postsutural dorsocentrals four; humerals three; sternopleurals three, widely spaced; prealar long; prosternum without setulae; postalar declivity bare; scutellum with two long marginal bristles, the apical pair crossed.

Abdomen black, silvery pollinose, with a well-defined black mid-dorsal stripe; hypopygium black, rather large; fifth sternite entire.

Wing hyaline; basicosta black; all veins without setulae; last section of fourth vein hardly twice length of preceding section, curved slightly posteriorly; calypters clear, rims yellowish orange; halteres orange.

Legs black; anterior tibia with long apical dorsal bristle; basal tarsal segment with a tuft of longer setae ventrally at base; midtibia with two median posterior bristles; hind tibia with three short median anterior ventral bristles, two median anterior dorsal bristles, and one long posterior bristle.

*Female*.—Like the male except for normal sexual differences.

*Type locality*.—Coeur d'Alene, Idaho.

*Type and paratypes*.—U.S.N.M. no. 51845.

*Host*.—*Dendroctonus monticolae* Hopkins.

*Remarks.*—Described from a series of 40 specimens: Holotype male and 36 paratype male and female specimens, Coeur d'Alene, Idaho, June 18, 1929 (H. J. Rust); 1 paratype female, Metaline, Wash., July 7, 1934 (W. D. Redard); 2 paratype females, Sula, Mont., June 25, 1929 (D. DeLeon).

This species differs from *Phaonia protuberans* Malloch in that the antennal axis and the vibrissal axis are subequal, the buccal length being produced in *protuberans*. It differs from *P. serva* Fallen in that the bases of the wings are not yellow or orange and from *P. savonoskii* Malloch in that the midtibia of both sexes lacks a median anterior dorsal bristle.

Pupae of these flies were found under the bark of lodgepole pine and western white pine, most abundantly in wet windfalls, according to James C. Evenden, entomologist, Forest Insect Laboratory, Bureau of Entomology and Plant Quarantine, Coeur d'Alene, Idaho. He states that they are always associated with the mountain-pine beetle in white pine and that they have not been found in wet windfalls that have not been attacked by this insect. D. DeLeon found pupae of this fly in egg galleries of *D. monticolae* at Sula, Mont., in nearly every instance.

The larvae are successfully reared upon larvae of *D. monticolae*, and during studies upon the insect at Sullivan Lake, Metaline Falls, Wash., in June 1932, larvae were found in the act of devouring *D. monticolae* larvae, and other larvae were found with their heads covered with beetle larval head capsules.



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THE PUPA OF *MYOCERA TABANIVORA* HALL  
(DIPTERA)

By CHARLES T. GREENE

*Bureau of Entomology and Plant Quarantine, United States Department of  
Agriculture*

THE ADULT of *Myocera tabanivora*, a new species of muscoid fly, was described by David G. Hall in the preceding paper.<sup>1</sup> Following is a description of the pupa:

*Pupa*.—Dull dark yellowish red, slightly darker at each end. Posterior end oblique in profile. Anterior spiracle large, piceous, shining, nearly quadrate, slightly smaller at base; outer surface with a depression in central basal portion; entire raised portion with tiny yellow tubercles; inner surface very finely rugose; spiracles located apically, separated by a distance equal to twice the length of one spiracle. Posterior spiracles located on but mostly above the horizontal axis, very large, shining black, narrowly separated by a vertical depression; each spiracle appearing to be in a pitlike depression, which is very deeply grooved on the inner lower half; each spiracle with three prominent elliptical lobes, each lobe having a sinuous, reddish-yellow slit extending the entire length; button very weak, represented only by a slight wrinkling in the deep groove where the three lobes meet. Anal plate blackish. (Fig. 27.)

<sup>1</sup> New muscoid flies (Diptera) in the United States National Museum, Proc U S Nat Mus, vol 54, p 206, 1937.

Length, 8 mm; diameter, 3 mm.

Reared from a tabanid larva collected in a woodland pond, Ramsey County, Minn., May 3, 1926, by C. B. Philip. Adult emerged on June 12, 1926; labeled Series N5-13.

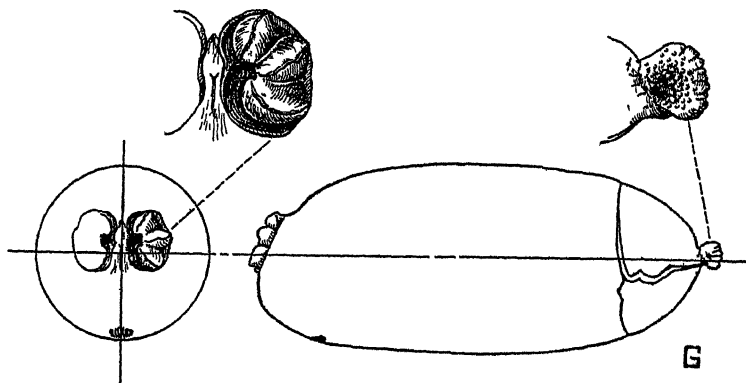


FIGURE 27.—Puparium of *Myosia tabanivora* HILL.



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## A NEW SUBSPECIES OF THE NYMPHALID BUTTERFLY *POLYGONIA FAUNUS*

By AUSTIN H. CLARK

*Curator, Division of Echinoderms, United States National Museum*

WILLIAM H. EDWARDS, in April 1862, described the butterfly *Grapta faunus*, which he said "is found abundantly in certain localities on the Catskill Mountains, New York. It is also found at Fort Simpson, at Albany River, and Lake Winnipeg." The type locality of *faunus* is therefore the Catskill Mountains. In his description of *Argynnis atlantis* Mr. Edwards mentioned that in 1861 he had found that species abundant near the Mountain House, and it was presumably at the same time and place that he secured his type series of *faunus*.

*Polygonia faunus* is one of the commonest and most characteristic butterflies of the Canadian Zone, from the highlands of New York and New England westward. In addition to many records of this insect from these northern regions, there are a few records from the southern extension of the Canadian Zone along the mountains from West Virginia to Georgia.

Among the watercolor drawings of the insects of Georgia by John Abbot in the British Museum dated 1792-1804, there is a figure identified by Samuel H. Scudder as *Polygonia faunus* that bears the manuscript note in Abbot's handwriting "met with by Mr. Elliot in his tour to the mountains."

Some time after publishing the original description, Edwards recorded a single individual of *faunus* that had been captured in

West Virginia by Meyer. In 1887 he mentioned *faunus* from Virginia, probably in error for West Virginia.

In 1892 Theodore L. Mead wrote that *faunus* is "abundant all along the roadsides from 4,000 to 5,000 feet" on Grandfather Mountain in Mitchell (now Avery) County, N. C., and in 1893 Dr. Henry Skinner recorded *faunus* from Cranberry, Avery County, at an elevation of 3,250 feet.

In 1905 F. E. Brooks recorded *faunus* from central West Virginia at an altitude of 3,500 feet.

C. S. Brimley and Franklin Sherman, Jr., in 1907 recorded *faunus* from Blowing Rock, Watauga County, N. C., at an altitude of 4,000 feet, and mentioned Dr. Skinner's record from Cranberry.

Dr. A. Glenn Richards, Jr., in 1931 recorded *faunus* from Andrews Bald in Swain County, N. C., where he found it on August 21-23, 1928, and noted that Henry K. Townes, Jr., had taken it on Cedar Mountain in southern North Carolina, very near the South Carolina line, on July 24, 1929.

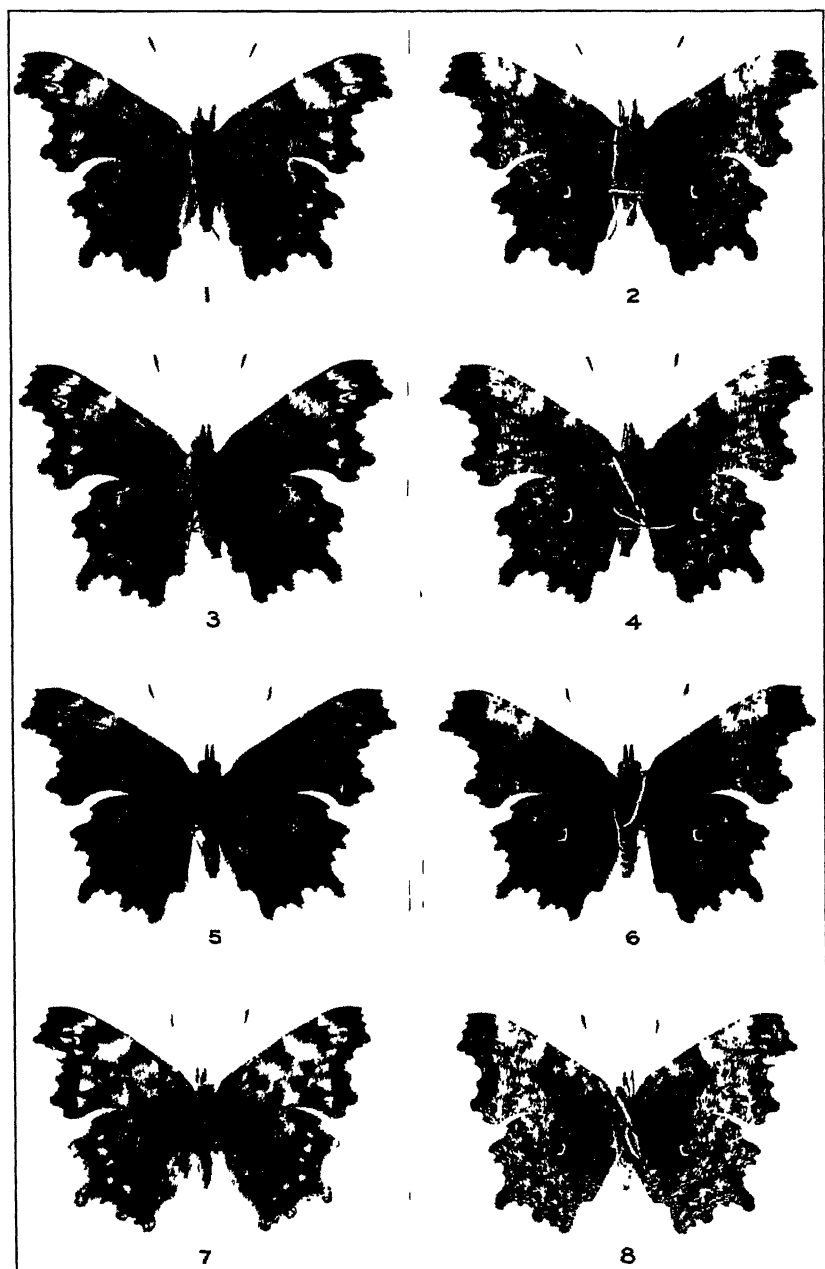
Prof. Franklin Sherman has been so kind as to send us unpublished records of this species from North Carolina, South Carolina, and Georgia. His record from South Carolina is the first from that State, and the two from Georgia are an interesting supplement to the single previous record by Abbot more than 130 years ago.

We are also greatly indebted to C. S. Brimley, of Raleigh, N. C., who has sent us the records from North Carolina in the files of the State Department of Agriculture, and to Henry K. Townes, Jr., of Greenville, S. C., who has sent us his records from South and North Carolina.

There is no published record of the occurrence of this butterfly in Virginia. We wrote to our friend Prof. Ellison A. Smyth, Jr., of the Virginia Polytechnic Institute at Blacksburg, Montgomery County, now retired and living at Salem, and asked him if he knew of any specimens from the State. He replied that in 1896 he had raised five individuals from larvae that he had found on gooseberry bushes in his garden at Blacksburg. His identification of these had been confirmed by William H. Edwards.

As the butterfly is common on Grandfather Mountain, a few miles south of the Virginia border, we assumed that it would be equally common in and about the spruce forests on White Top and Balsam Mountain (Mount Rogers), the highest mountains in Virginia, not far to the northward. We therefore visited these mountains on July 9-15, 1936, and as we had expected found it in considerable numbers, all the individuals being freshly emerged.

On July 21 we visited the Biological Station of the University of Virginia at Mountain Lake, in Giles County, Va., where we were told by Prof. Lorande Loss Woodruff that he had captured it there.



1-6. *Polygonia faunus smythi*, new subspecies: 1, Male, Mount Rogers (Balsam Mountain), Grayson County, Va., A. H. Clark, July 15, 1936, type (U. S. N. M. no. 51846); 2, same, under side; 3, female, White Top Mountain, Grayson County, Va., L. F. Clark, July 10, 1936; 4, same, under side; 5, male, White Top Mountain, Va., A. H. Clark, July 10, 1936; 6, same, under side.  
7, 8. *P. f. faunus* (W. H. Edwards): 7, Male, Mount Washington, N. H., 4,000 feet, August 1-7; 8, same, under side.





Later Professor Woodruff was so kind as to send us his specimens for examination.

All the individuals of *Polygonia faunus* that we captured, the two in the National Museum collection from Grandfather Mountain and Andrews Bald, and those sent us by Professor Woodruff differ markedly from the large number at hand from New York and New England and northward and northwestward. It is therefore clear that there is a distinct southeastern race of this butterfly confined to the narrow and more or less discontinuous southern extension of the Canadian Zone. This may be known as

**POLYGONIA FAUNUS SMYTHI, new subspecies**

**PLATE 10, FIGURES 1-6**

*Description.*—Resembling *Polygonia faunus faunus*, but slightly larger; *above*, darker, the ground color slightly more reddish, the dark markings blackish brown, and the submarginal spots in the dark border of the hind wings usually smaller, often obsolescent; *below*, darker, usually much darker, the light and dark markings, especially on the hind wings, less contrasting.

*Type specimen.*—From Mount Rogers (Balsam Mountain), Grayson County, Va., about 4,000 feet, male, July 15, 1936; A. H. Clark. U.S.N.M. no. 51846.

*Specimens examined.*—VIRGINIA: White Top Mountain, Grayson County, July 10, 11, 1936, A. H. and L. F. Clark (five); Mount Rogers, Grayson County, July 15, 1936, A. H. and L. F. Clark (one); Mountain Lake, Giles County, July 7, 9, 15, 24, 1936, L. L. Woodruff (four). NORTH CAROLINA: Grandfather Mountain, Avery County, about 6,000 feet, August 1892, T. L. Mead (one); Andrews Bald, Smoky Mountain Park, Swain County, 5,750 feet, August 22, 1928, A. G. Richards, Jr. (one).

*Range.*—WEST VIRGINIA: No further data (W. H. Edwards); central West Virginia, about 3,500 feet (F. E. Brooks). VIRGINIA: Blacksburg, Montgomery County (E. A. Smyth, Jr.); Mountain Lake, Giles County (L. L. Woodruff); White Top Mountain and Mount Rogers, above 4,000 feet (A. H. and L. F. Clark). NORTH CAROLINA: Grandfather Mountain, Avery County, 4,000 to 5,000 feet (T. L. Mead); Cranberry, Avery County, 3,250 feet (H. Skinner); Blowing Rock, Watauga County, 4,000 feet (Brimley and Sherman); Mount Mitchell, Yancey County, 6,000 feet, August 20, 1926, J. C. Crawford (C. S. Brimley, *in litt.*); Big Pisgah Mountain, Haywood County, 4,800 feet, July 19, 1932, common (Henry K. Townes, Jr., *in litt.*); Andrews Bald, Smoky Mountain Park, Swain County, 5,950 feet (A. G. Richards, Jr.); Smokemont, Swain County, June 30, 1934, T. B. Mitchell (C. S. Brimley, *in litt.*); Cedar Mountain, Transylvania County, 2,700 feet, Henry K. Townes, Jr. (A. G. Rich-

ards, Jr.); Cedar Mountain, 2,900 feet, June 29, 1933, July 24, 1929, and July 22, 1931 (Henry K. Townes, Jr., *in litt.*); Highlands, Macon County (Franklin Sherman, *in litt.*). SOUTH CAROLINA: Greenville County, Henry K. Townes, Jr. (Franklin Sherman, *in litt.*); River Falls, Greenville County, 3,000 feet, not rare (Henry K. Townes, Jr., *in litt.*). GEORGIA: In the mountains (John Abbot, according to S. H. Scudder); Satolah, Rabun County (Franklin Sherman, *in litt.*); Rabun Bald Mountain, Rabun County (Franklin Sherman, *in litt.*).

*Season*.—This butterfly appears locally from the end of June to the middle of July and flies until September. Mr. Townes writes that where he has collected it it is commonest in its prime in the first half of July. On White Top and Balsam Mountains it does not appear until the second week in July. There is only a single brood.

*Occurrence*.—The butterfly is common wherever it occurs regularly, frequenting especially roads through the woods, clearings, and the borders of wooded areas.

*Food plant*.—Gooseberry (Ellison A. Smyth, Jr.).

*Remarks*.—Three other species of *Polygonia* occur in Virginia. One of these, *P. progne*, is confined to the mountainous region in the western part of the State, where it is very common in the Transition Zone, at the higher altitudes overlapping the lower portion of the range of *P. faunus smythi*. The two other species, *P. interrogationis* and *P. comma*, occur at all points in the State, though they are generally less numerous on the Coastal Plain than elsewhere; *P. interrogationis* is frequent or rather common almost everywhere, but *P. comma* is less numerous and is nowhere found in any great numbers. Neither *P. interrogationis* nor *P. comma* is at any point so common as are *P. faunus smythi* and *P. progne* in the regions where the two latter occur.

On the lower borders of the range of *P. faunus smythi* all four species are found, *P. progne* far outnumbering the others. At one place on White Top Mountain where a small stream crosses the road up the mountainside we took *P. faunus smythi*, *P. progne*, and *P. comma* within a few minutes on the same square foot of moist earth.

Although in *Polygonia faunus* the individuals from Virginia and southward represent a local race quite distinct from the typical northern form, we fail to detect any corresponding differences between southern and northern specimens of *P. progne*, *P. comma*, or *P. interrogationis*. Southern individuals of these three species are frequently somewhat larger and darker than individuals from farther north, but the differences are slight and inconstant and are confined to relatively few specimens.



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## A NEW SPECIES OF TREMATODE FROM THE MUD-EEL (SIREN LACERTINA)

By C. COURSON ZELIFF

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AN EXAMINATION of material scraped from the intestinal mucosa of the mud-eel (*Siren lacertina* Linnaeus) disclosed the presence of a minute trematode, herein described as a new species of the genus *Cercorchis* Lühe, 1900.

The confusion of the genera *Cercorchis* and *Telorchis* Looss, 1899, appears to have been settled by Perkins (1928), who raised *Cercorchis* to full generic rank. Harwood (1932) accepts this distinction and points out the necessity of transferring all North American species of the genus *Telorchis* to *Cercorchis*. Stunkard (1916) described *T. corti*, *T. lobosus*, *T. medius*, and *T. diminutus*; MacCallum (1918) *T. insculpti*, *T. pallidus*, *T. chelopi*, and *T. guttati* from turtles; Chandler (1923) *T. stunkardi* from *Amphiuma means*; Perkins (1928) *C. necturi* from *Necturus maculosus*; Ingles (1930) *T. stenonura* from *Clemmys marmorata*; Mehra and Bokhari (1931) *C. dhongokvi* from the tortoise *Kachuga ahongoka* of India; Harwood (1932) *C. texanus* and *C. bairdi* from reptiles; Bennett (1935) *C. singularis* from two genera of turtles (with a discussion of the genera as defined by Perkins); and Byrd (1936) *C. kinosterni* from the mud turtle. No claim of completeness is vouched for in the list given. The relationship that exists between *Siren* and *Amphiuma*, including also the proximity of habitat of these and the mud turtle *Kinosternon*, does not necessarily mean that the

species of *Cercorchis* inhabiting them are the same. From the standpoint of morphology the species from *Siren lacertina* differs considerably from the numerous drawings and descriptions of the species studied.

Family TELORCHIIDAE Stunkard, 1924

Subfamily TELORCHIINAE Looss, 1899

Genus CERCORCHIS Lühe, 1900

CERCORCHIS SIRENIS, new species

PLATE 11

*Specific diagnosis.*—The mature worms available for study have a length of 0.78 to 1.56 mm and a width of 0.19 to 0.31 mm at the anterior edge of the acetabulum. In thickness they measure about 0.11 to 0.14 mm near the acetabulum. Spination is marked at the anterior end. The ends in the fixed specimens taper somewhat and are slightly flattened or rounded. The oral sucker is 0.11 by 0.09 to 0.13 by 0.11 mm in diameter. The prepharynx is approximately 0.01 mm in length. The pharynx is somewhat oblong and is 0.03 by 0.04 to 0.04 by 0.04 mm. The esophagus is 0.02 to 0.03 mm in length. The intestinal caeca end very little cephalad or caudad of the posterior testis. The acetabulum is 0.10 mm in diameter if circular, or 0.12 by 0.11 to 0.12 by 0.09 mm in diameter if somewhat elliptical in outline. The spherical ovary is about 0.06 mm in diameter and is located slightly anterior of the middle of the organism or central in position. The vitellaria are arranged in follicles and extend from the posterior border of the acetabulum to the anterior border of the anterior testis. The posterior part of the vagina, or metraterm, runs ventral to the cirrus sac, the latter crossing over the former. The cirrus sac, including the seminal vesicle and prostate parts, extends in waves from the posterior dorsal border or middle of the ovary to the genital pore, into which it opens jointly with the vagina. The large genital pore is located at the anterior left border of the acetabulum. The ova in a collapsed condition are  $13\mu$  by  $39.6\mu$  and in the more normal shape  $19.8\mu$  by  $36.3\mu$  to  $16.5\mu$  by  $42.3\mu$ . The testes, which are not uniformly spherical, are located near the caudal end and the posterior one is slightly larger than the anterior. The anterior testis measures 0.04 by 0.07 to 0.8 by 0.11 mm and the posterior 0.06 by 0.10 mm.

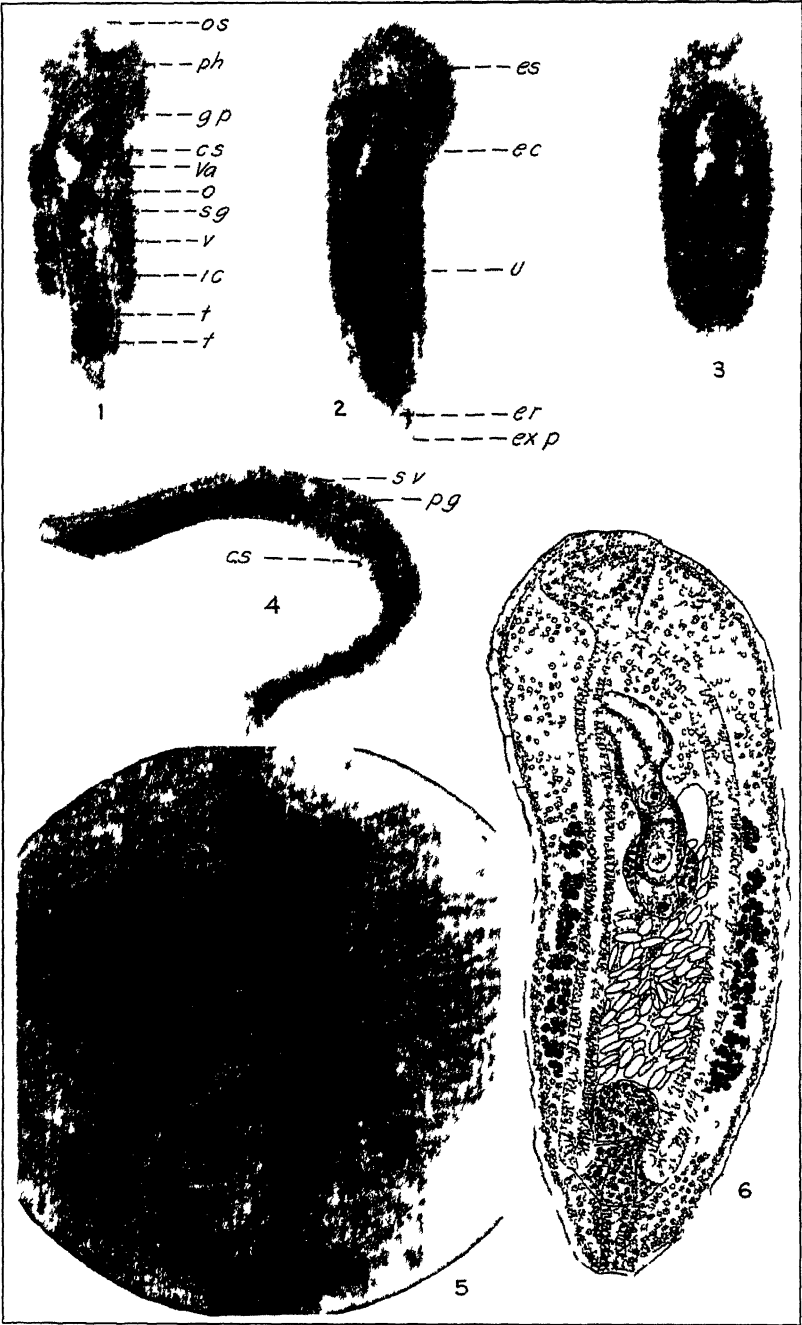
*Host.*—*Siren lacertina* Linnaeus.

*Habitat.*—Intestine.

*Locality.*—Southeastern United States.

*Type specimens.*—U.S.N.M. Helm. Coll. no. 9021.

*Remarks.*—Fixation may result in a slight change in the size or contour of the organs as it does in the contour of the body. An



CERCORCHIS SIRENIS NEW SPECIES  
FO EXPLANATION OF PLATE SEE BOTTOM OF PAGE 6



ootype, Laurer's canal, seminal receptacle, oviduct, and vitelline receptacle have not been observed or are not clearly defined. In *C. sirenis* the esophagus is shorter, and the caeca do not terminate regularly in the intertesticular zone as in *T. parvus* Braun, 1901. There is considerable variation between this species and *T. medius*, *T. corti*, *T. lobosus*, and *T. diminutus* described by Stunkard (1916). Although the measurements approach the last-named species, the caeca of *C. sirenis* do not extend so far posterior, the esophagus is shorter, the cirrus sac extends to the ovary, and the vitellaria are grouped. The size of the body and various organs, including the shorter caeca of *C. sirenis*, separates it from *T. insculpti*, *T. pallidus*, *T. guttati*, and *T. chelopi* described by MacCallum (1918). The caeca do not extend so far caudad of the posterior testis, the length is much less, and the ova are smaller in the collapsed and noncollapsed condition than is given by Chandler (1923) for *T. stunkardi* from *A. means*. The species is much smaller than *C. necturi* described by Perkins (1928) and also it differs in having a prepharynx, smaller pharynx, shorter esophagus, less caudad caeca, and ova, ovary, testes, and other organs of noticeable differences of dimensions. In contrast with *T. stenonura*, a species that apparently belongs in *Cercorchis*, recorded from *Clemmys marmorata* by Ingles (1930), the smaller size, shorter caeca, and location of the genital pore are points of difference. When compared with *C. texanus*, *C. bairdi*, and *C. singularis*, the more minute size and the more cephalad caeca of *C. sirensis* are very noticeable points that distinguish it from the descriptions given by Harwood (1932) and Bennett (1935) of these species. Compared with *C. kinosterni*, recently described by Byrd (1936), the esophagus of *C. sirenis* is much shorter, the caeca extend less posterior, and the vitellaria are more anterior. In this last comparison the differences in measurements of some of the organs and the bodies are not large. Other differences of the measurements of organs are probably more or less important for all species concerned. The drawing (pl. 11, fig. 6) was made with the camera lucida.

Keys to the species of *Telorchis* are given by Goldberger (1911) and Dollfus (1929). Perkins (1929) gives a key to *Cercorchis*, which includes transfers from the genus *Telorchis*.



## LITERATURE CITED

- BENNETT, HARRY J.  
1935. Four new trematodes from reptiles. *Journ. Parasit.*, vol. 21, pp. 83-90, 2 pls.
- BYRD, ELON E.  
1936. A new trematode parasite from the mud-turtle, *Kinosternon subrubrum hippocrepis* (Gray). *Journ. Parasit.*, vol. 22, pp. 413-415, 3 figs.
- CHANDLER, ASA CRAWFORD.  
1923. Three new trematodes from *Amphiuma means*. *Proc. U. S. Nat. Mus.*, vol. 63, art. 3, 7 pp., 2 pls.
- DOLLFUS, ROBERT.  
1929. Sur le genre *Telorchis*. *Ann. Parasit. Hum. et Comp.*, vol. 7, pp. 29-54, 116-132, 17 figs.
- GOLDBERGER, JOSEPH.  
1911. On some new parasitic trematode worms of the genus *Telorchis*. *U. S. Hyg. Lab. Bull.* 71, pp. 36-47.
- HARWOOD, PAUL DUANE.  
1932. The helminths parasitic in the Amphibia and Reptilia of Houston, Texas, and vicinity. *Proc. U. S. Nat. Mus.*, vol. 81, art. 17, 71 pp., 5 pls.
- INGLES, ILOYD GLENN.  
1930. A new species of *Telorchis* from the intestine of *Clemmys marmorata*. *Journ. Parasit.*, vol. 17, pp. 101-103, 1 fig.
- MACCALLUM, GEORGE ALEXANDER.  
1918. Notes on the genus *Telorchis* and other trematodes. *Zoopathologica*, vol. 1, no. 3, pp. 81-98, 15 figs.
- MEHRA, H. R., and BOKHARI, M. A.  
1931. On new distomate trematodes of the sub-family Telorchinae (family Lepodermatidae) with a systematic discussion of its genera. *Allahabad Univ. Studies*, vol. 8, pt. 2 (sci. sect.), pp. 47-62, 3 pls.
- PERKINS, MICHAEL.  
1928. A review of the Telorchinae, a group of distomid trematodes. *Parasitology*, vol. 20, pp. 336-356, 2 pls.
- STUNKARD, HORACE WESLEY.  
1916. Notes on the trematode genus *Telorchis* with descriptions of new species. *Journ. Parasit.*, vol. 2, pp. 57-60, 2 figs., 1 pl.

## EXPLANATION OF PLATE

1-3, Ventral views; 4, lateral view; 5, view of acetabular region and genital pore; 6, dorsal view

ac. Acetabulum.	o. s. Oral sucker.
c. s. Cirrus sac.	p. g. Prostate gland.
e. c. Excretory canal.	ph. Pharynx.
e. r. Excretory reservoir or vesicle.	s. g. Shell gland.
es. Esophagus.	s. v. Seminal vesicle.
ex. p. Excretory pore.	t. Testis.
g. p. Genital pore.	u. Uterus.
i. c. Intestinal caeca.	v. Viltellaria.
o. Ovary.	va. Vagina, or metraterm.



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## MEXICAN FOSSIL ECHINI

By ROBERT TRACY JACKSON

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THE collection of fossil Echini reported upon in this paper was submitted to me for study by Dr. T. Wayland Vaughan. All types of new species described herein are in the United States National Museum except that of *Lovenia mexicana*, which is in the museum of the California Academy of Sciences, San Francisco.

I should express my warm appreciation to my friend Dr. Hubert Lyman Clark for his help in this work. His opinion is of great value, especially in the cidaroids and clypeastroids, for the identification in these two groups is exceptionally difficult on account of the multiplicity of species, and Dr. Clark is a high authority on both groups. Assistance in stating precisely the localities and the geologic horizons has been kindly rendered by J. M. Muir and Thomas F. Grimsdale.

The regular Echini are represented by only two species of *Cidaris* and one of *Stomopneustes*. This last is of exceptional interest, as it is the first recorded occurrence of the genus as found fossil in America. Indeed, its previous occurrence as a fossil anywhere is somewhat doubtful. The clypeastroids, as usual in Tertiary collections, are rather abundant in species and individuals. Of spatangoids there are a number of species, and the specimens are in an exceptionally good state of preservation.

Table 1 shows the localities and the geologic horizons of the species found in the collection.

TABLE 1.—Localities and geologic horizons of species of Mexican fossil Echini recorded in this paper

Species	Localities	Horizon
<i>Cidaris loveni</i> Cotteau.....	Túxpan City, Veracruz.....	Miocene, Túxpan formation
<i>i howarsi</i> Agassiz and Desor.....	do.....	Do.
<i>Stomopneustes pristinus</i> , new species.....	Hacienda Tierra Amarilla, about 7 km NW. of town of Temapache, Veracruz.	Oligocene, Mesón formation.
<i>Clypeaster meridanensis</i> Michelin.....	{Hacienda Santa Fé, Topila Hills, Veracruz. Túxpan City, Veracruz.....	Do.
<i>martianus</i> , new species.....	2.5 km SW. of Mesón Village; Topila; other localities.	Miocene, Túxpan formation
<i>topilanus</i> , new species.....	Hacienda Santa Fé, Topila.....	Oligocene, Mesón formation.
<i>Laganum leptum</i> , new species.....	8 km E. of town of Chinampa.....	Do.
<i>Scutella cazonesensis</i> Kew.....	La Cuesta, Soto la Marina River.....	Do.
<i>Agassizia clevei</i> Cotteau.....	Salitre Ranch.....	Not definitely known, Oligocene or Miocene.
<i>Schizaster cristatus</i> Jackson.....	8 km E. of town of Chinampa and other localities.	Oligocene, Mesón formation.
<i>Eupatagus mexicanus</i> , new species...	Hacienda Santa Fé, Topila.....	Do.
<i>Loventa dumblei</i> Kew.....	10 km E. of town of Chinampa.....	Do.
<i>mexicana</i> , new species.....	2.5 km SW. of Mesón Village.....	Do.

Dickerson and Kew have published a paper<sup>1</sup> in which Kew, who is the author of the echinoid portion, recognized 12 species of Echini, four of which were described as new. Merle C. Israelsky<sup>2</sup> described six new species of Echini from Mexico and recorded in all 13 species from that region. Errors in localities as cited by Israelsky are corrected in a book by J. M. Muir.<sup>3</sup> Additional fossil Echini from Mexico are included in a paper by the veteran echinologist M. Jules Lambert,<sup>4</sup> who had only a limited amount of material, some 12 specimens, which he referred to eight species, three of which were described as new.

In the material on which the present paper is based 13 species are recorded, six of which are new. In all, 32 species have been recorded from Mexico, 18 of which were described as new.

<sup>1</sup> The fauna of a medial Tertiary formation and the associated horizons of northeastern Mexico. Proc. California Acad. Sci., ser. 4, vol. 7, no. 5, pp. 125-156, pls. 17-26a, 1917.

<sup>2</sup> Notes on some echinoids from the San Rafael and Túxpan beds of the Tampico region, Mexico. Proc. California Acad. Sci., ser. 4, vol. 13, no. 8, pp. 137-145, pls. 2-4, 1924.

<sup>3</sup> Geology of the Tampico embayment, xix+280 pp., illus. American Association of Petroleum Geologists, 1935.

<sup>4</sup> Note sur quelques Echinides recueillis par Mr. Walter Staub dans le Néogène de l'Est du Mexique. Eclog. geol. Helv., vol. 21, no. 1, pp. 272-283, 6 figs., 1 pl., 1928.

## Order CIDAROIDA Duncan

## Family CIDARIDAE Gray

## Genus CIDARIS Leske

## CIDARIS LOVENI Cotteau

*Cidaris loveni* COTTEAU, Kongl. Svenska Vet.-Akad. Handl., vol. 13, no. 6, p. 10, pl. 1, figs. 11–14, 1875.—JACKSON, Carnegie Inst. Washington Publ. 306, p. 19, pl. 1, figs. 8–10, 1922.

A fragment consisting of an interambulacral area and a half-ambulacral area appears referable to this species, although it is considerably larger than the type, which is from the Eocene of St. Bartholomew, West Indies. The Mexican specimen measures 29 mm in height, width of the interambulacrum at the midzone 22 mm, width of the half-ambulacrum at the same zone 3 mm. This, of course, indicates 6 mm as the width of the ambulacral area. This species is recorded qualifiedly as *Cidaris* cf. *loveni* by Kew and also by Israelsky as from Tuxpan, based apparently on the same specimen here considered.

Miocene, Tuxpan formation, Tuxpan, Veracruz, Mexico; Dumble and Cummins, collectors, 1908, California Academy of Sciences, locality X 14, one specimen.

## CIDARIS THOUARSII Agassiz and Desor

*Cidaris thouarsii* AGASSIZ and DESOR, Catalogue Raisonné, Ann. Sci. Nat., ser. 3, vol. 6, p. 326, 1846.

A specimen somewhat crushed but otherwise fairly well preserved is referred to this species. It measures 17 mm in height, width of an ambulacrum at the midzone about 3 mm, width of an interambulacrum at the same zone 14 mm. *Cidaris thouarsii* occurs in the Recent fauna of the Pacific off the west coast of Mexico. It is of interest that it is found also in the fossil state in Mexico. *C. tribuloides*, which is abundant in the Recent West Indian fauna, has been found fossil in Cuba.

Miocene, Tuxpan formation, Tuxpan, Veracruz, Mexico; Dumble and Cummins, collectors, 1908, California Academy of Sciences, locality X 14, one specimen.

## Order CENTRECHINOIDA Jackson

## Suborder STIRODONTA Jackson

## Family STOMOPNEUSTIDAE Mortensen

## Genus STOMOPNEUSTES Agassiz

## STOMOPNEUSTES PRISTINUS, new species

## PLATE 12, FIGURE 1

Test low, dome-shaped, ambitus below the midzone, slightly pentagonal in horizontal outline, the ambulacral areas coinciding with

the apices of the pentagon, flattened dorsally, slightly reëntrant about the peristome, otherwise very nearly flat ventrally. Ambulacra wide, measuring about 25 mm in width at the ambitus, ambulacral plates composed of three elements, but this species, like the Recent *S. variolaris* (Lamarck), has a peculiar arrangement in that every fourth ambulacral plate bears a large primary tubercle that has grown over four plates and hides their sutures. This, with other important details in regard to the Recent species, is considered by Dr. H. L. Clark.<sup>5</sup> Interambulacra with two vertical rows of primary tubercles in each half-area. Diameter of the specimen 81 mm, height 38 mm.

The single known specimen (U.S.N.M. no. 496275) of this new and interesting echinoid is much worn and shows structural detail only in parts of the test. The peristome and periproct are not preserved, or are not visible. The test is thick and solid and gives no evidence of flattening or other distortion.

The genus *Stomopneustes* is known from the Recent species *S. variolaris* (Lamarck) from the southern Pacific Ocean. According to Duncan,<sup>6</sup> a species has been found in the Tertiary of Java, but he queried the statement.

Oligocene, Mesón, Hacienda Tierra Amarilla, about 7 km northwest of the town of Temapache, Canton Tuxpan, Veracruz, Mexico; Corona collection, no. 29 (= H176), one specimen.

## Order EXOCYCLOIDA Jackson

### Suborder CLYPEASTRINA Gregory

#### Family CLYPEASTRIDAE Agassiz

##### Genus CLYPEASTER Lamarck

##### CLYPEASTER MERIDANENSIS Michelin

*Clypeaster meridanensis* MICHELIN, Rév. et Mag. Zool., ser. 2, vol. 2, p. 240, 1850; Mém. Soc. Geol. France, ser. 2, vol. 7, p. 136, pl. 14, figs. 1a-f, 1861.

Of the species *Clypeaster meridanensis*, described by Michelin from the Tertiary of Merida, Yucatan, there is a fine series of extremely well preserved specimens from Tuxpan, Tampico, and Hacienda Santa Fé, Topila, Mexico. The largest specimen, from a small quarry in the town of Tuxpan, collected by D. R. Semmes, no. 82, measures 160 mm in length, 142 mm in width at the widest part through ambulacra II and IV, and 27 mm in height.

There are 12 specimens of this species from the Miocene of Tuxpan, Veracruz, Mexico, and two from the Oligocene Mesón formation of Hacienda Santa Fé, Topila, Veracruz. Also there is a 4-rayed specimen and a fragment from 1 mile north of Tampico and on the opposite

<sup>5</sup> Mem. Mus. Comp. Zool., vol. 34, no. 2, 1912.

<sup>6</sup> Revision of the genera and great groups of the Echinoidea. Journ. Linn. Soc. London, Zool., vol. 23, pp. 1-311, 1889.

side of Laguna del Carpintero from it; California Academy of Sciences, locality X 34. A specimen with petals broader and poriferous areas wider than is usual in the species as a variant is from Tuxpan, Veracruz, California Academy of Sciences, locality X 14.

Lambert<sup>7</sup> also records this species from Tuxpan.

CLYPEASTER MARINANUS, new species

PLATE 12, FIGURE 2; PLATE 13, FIGURE 1

Test elongate, low, subpentagonal in outline, very thin on the borders, center only slightly elevated, ventrally nearly flat, slightly reentrant around the mouth. Ambulacral petals relatively short, slightly curved, open at the tips, nearly flush with the surface of the test, poriferous areas not sunken. Apical disk slightly anterior to the center. Periproct near the posterior end; in a specimen 72 mm long the periproct is 6 mm from the border. Tubercles are small dorsally and closely associated; ventrally they are larger and more deeply sunken.

There is a rather large series of specimens of this species from several localities. The specimen selected as the type, H 120 (U.S.N.M. no. 496276), from Chamal on the north side of Soto la Marina River, measures 102 mm in length, 94 mm in width, and about 20 mm in height. Another specimen, from Hacienda Santa Fé, Topila, measures 116 mm in length, 98 mm in width, and about 17 mm in height.

*Clypeaster marinanus* approaches in character nearest to *C. rogersi* Morton but differs from that in having the test flatter and being much thinner at the margin and less deeply reentrant around the mouth. Also the ambulacral petals are shorter, narrower, and less curved, and the poriferous areas are narrower in *rogersi*. *C. marinanus* differs from *C. staudi* Lambert, which also occurs east of Soto la Marina, in that the test of *marinanus* is much less conically elevated and much less pentagonal in outline than *staudi*.

Oligocene, Mesón formation, at the following localities: Chamal, Soto la Marina River, Tamaulipas, Mexico, Corona collection, six specimens including the holotype; Mesón, Hacienda Santa Fé, Topila, Veracruz, six specimens; Lot 214 Hacienda Chinampa, 10 km east of town of Chinampa, Canton Tuxpan, Veracruz, just above the main *Lepidocyclus gigas* beds, top of Mesón formation, three small immature specimens; east of Ozuluama, one specimen; Mesón formation, Aguila Colony, about 4 km northwest of the cathedral, Tampico, Mexico, one specimen; north of Arbol Grande, between 3,700 and 4,300 feet north of Arbol Grande station, near Tampico, Mexico, several fragments; cut on street railway between Dona Cecilia and Tampico, Mexico, one fragment, California Academy of Sciences, locality X 118.

<sup>7</sup> *Op. cit.*, p. 272.

## CLYPEASTER TOPILANUS, new species

## PLATE 13, FIGURES 2, 3

*Clypeaster* sp. *a* KEW, Proc. California Acad. Sci., ser. 4, vol. 7, no. 5, table facing p. 128 (for localities listed), pp. 130, 131, pl. 23, fig. 2; pl. 24, fig. 2, 1917.

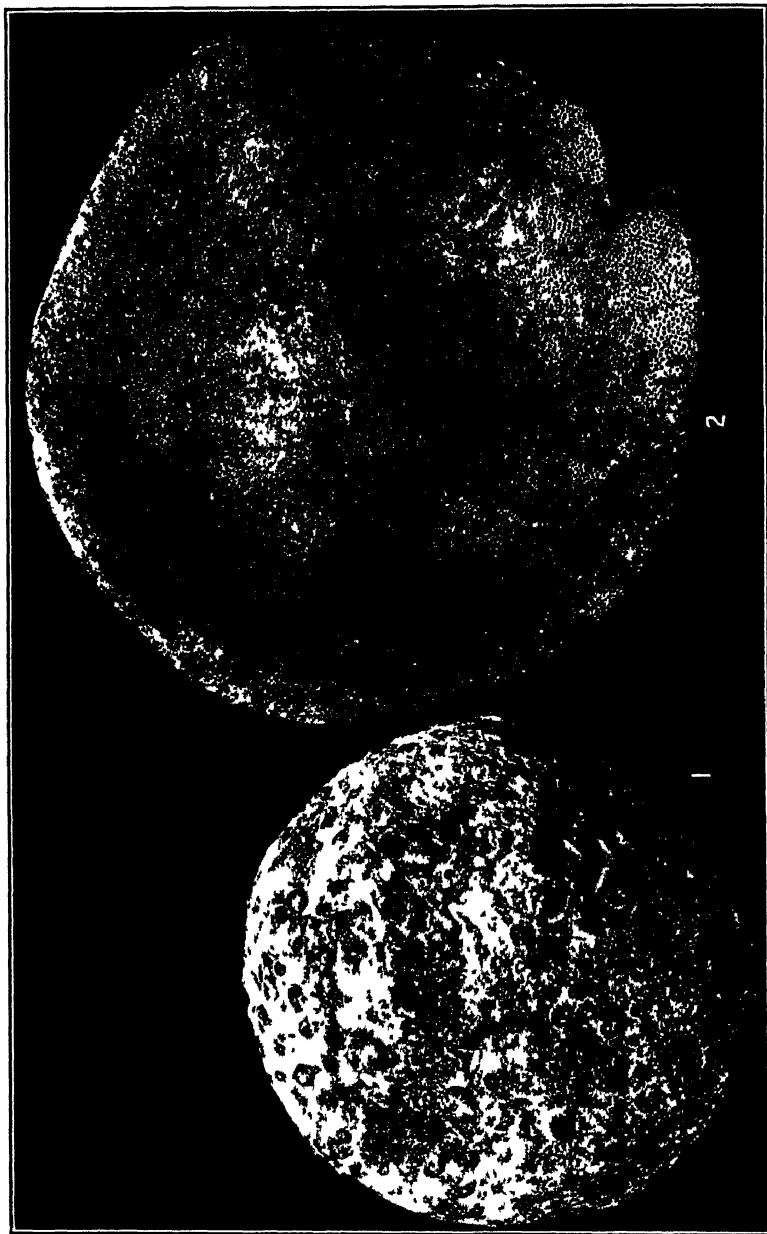
*Clypeaster* sp. ISRAELSKY, Proc. California Acad. Sci., ser. 4, vol. 13, no. 8, p. 140, 1924.

Test moderately high, pentagonal, elongate anteriorly, truncate posteriorly, with thick rounded margin, dorsally elevated into a low dome, ventrally reëntrant to the moderately sunken peristome. Apical disk small, a little anterior to the center of the test. Periproct near the posterior border of the test, 5 mm from it in the type, which measures 96 mm in length. Ambulacral petals open at the tips, poriferous areas narrow, moderately depressed, nonporiferous areas only moderately elevated.

There is a rather large number of specimens of this species. The one selected as the type (U.S.N.M. no. 496278) measures 96 mm in length, 80 mm in width, and 25 mm in height. With all the species assigned to the genus *Clypeaster*, it is annoying to make still another, but these specimens cannot be made to fit into any species known. *C. topilanus* is nearest to *C. planipetalus* Cotteau, but it differs from that in having shorter petals and being less open at the tips; also the petals are straighter and the poriferous areas are narrower than they are in *planipetalus*. *C. topilanus* is more massive and more strongly pentagonal in outline than *C. sanrafaelensis* Israelsky, which is from the Tampico region.

The species that Kew figured as *Clypeaster* species *a* is evidently the same as that described here as new. Kew did not give any description of his species *a*, but it is listed in his table of species from the "San Fernando formation and associated beds." As noted on page 125 (footnote) of Dickerson and Kew's paper, the name "San Fernando" being preoccupied, the name "San Rafael" was proposed as a substitute by Prof. E. T. Dumble. That name has now been dropped, as it was a synonym of the Mesón formation. Kew gave as localities for his species *a*: Salitre Ranch, Tamaulipas; and hill at extreme north of La Puerta Range, Hacienda Santa Fé, Topila, Veracruz.

In the material at hand there is a fine series from the Mesón formation at abandoned Corona camp, Hacienda Santa Fé, Topila, Veracruz, Mexico, 16 specimens. One specimen without locality is marked locality X 83a, California Academy of Sciences.



1, *Stomopneustes pristinus*, new species, Oligocene, Mesón formation, Hacienda Tierra Amarilla, Mexico, Corona collection no. 29, holotype, dorsal view, U.S. N. M. no. 496275, 2, *Cyppeaster marrianus*, new species, Mesón formation, Chamal on north side of Soto la Marina River, Corona collection no. H120, holotype, dorsal view, U. S. N. M. no. 496276 (Five sixths natural size)





1, *Clypeaster marinanus* new species Meson formation Hacienda Santa Fe Topila Mexico locality MIV paratype ventral view U S N M no 496277 2 *C. topilanus* new species same formation and locality holotype dorsal view U S N M no 496278 3 *C. topilanus* same formation and locality (chronic collection no 14 paratype ventral view U S N M no 496279 4 *Jagannum leptum* new species Meson formation on line of Transcontinental Railroad lot 145 Hacienda Chirumpi 8 km east of town of Chirumpi (in town Tuypan Veracruz at the first cut examined November 28 1920 holotype dorsal view U S N M no 496290 (Five sixths natural size)



*Eusotagus mexicanus* new species. Meson formation Hacienda Santa Fe, Topila, Mexico. Corona collection no. 1 holotype dorsal view. U. S. N. M. no. 496281. The figure is slightly foreshortened (five sixths natural size).



1 *Eupadops mexicanus*, new species. Me on formation Hacienda Santa Fe Topila Mexico Corona collection no 1 holotype ventral view of same specimen as pl 11 2 *Loxena mexicana* new species Rancho Nuevo 20 km WSW of Me-on, Canton Tuxpan Veracruz W F Cummins collector Calif Acad Sci, locality X62 holotype dorsal view 3 *L. mexicana* same locality and collector paratype ventral view of a larger specimen than fig 2 (Five-sixths natural size)

## Family LAGANIDAE Desor

## Genus LAGANUM Gray

## LAGANUM LEPTUM, new species

## PLATE 13, FIGURE 4

Test very nearly circular, very flat and thin. Apical disk central, peristome probably the same, but invisible. Ambulacral petals short, wide, obovate. Poriferous areas wide. Periproct very near to, being only 2 mm from, the posterior border of the test.

The single known specimen (U.S.N.M. no. 496280) measures 38 mm in length, 35 mm in width, and about 5 mm in height. This species approaches perhaps nearest to *Laganum johnsoni* Twitchell, from the Eocene of Alabama. It differs from *johnsoni* in the extreme thinness of the test and in the shortness and obovate form of the petals in *leptum*.

*L. leptum* was collected by Dr. T. W. Vaughan in the Oligocene Mesón formation on the line of the Transcontinental Railroad, lot 145, Hacienda Chinampa, 8 km east of the town of Chinampa, Canton Tuxpan, Veracruz, Mexico, at the first cut examined, November 28, 1920.

## Family SCUTELLIDAE Agassiz

## Genus SCUTELLA Lamarck

## SCUTELLA CAZONESSENSIS Kew

*Scutella cazonesensis* Kew, Proc. California Acad. Sci., ser. 4, vol. 7, p. 132, pl. 19, fig. 1, 1917.

This species is represented by a fragmentary but very well preserved specimen of an individual almost exactly the same size as the one figured by Kew.

The specimen here considered is from La Cuesta, Soto la Marina River, Corona collection, no. 28. The geologic horizon is not definitely known, but is either upper Mesón or Tuxpan.

## Suborder SPATANGINA Jackson

## Family HEMIASTERIDAE H. L. Clark

## Genus AGASSIZIA Valenciennes

## AGASSIZIA CLEVEI Cotteau

*Agassizia clevei* COTTEAU (pars), Kongl. Svenska Vet.-Akad. Handl., vol. 13, no. 6, p. 33, pl. 6, figs. 2-8, 1875.—JACKSON, Carnegie Inst. Washington Publ. 306, p. 71, pl. 12, figs. 5-7, 1922.

Not *Agassizia clevei* Kew, Proc. California Acad. Sci., ser. 4, vol. 7, pl. 17, figs. 1a, 1b, 1917.

Two specimens are referred to this species. The larger of the two as a variant shows considerable resemblance to *A. inflata* Jackson.

Kew figures a specimen as *A. clevei* as noted above. This specimen Israelsky<sup>8</sup> makes the type of a new species, *A. regia*, and compares this with *A. inflata* Jackson, which by error he calls *A. elevata* Jackson. *A. clevei* differs from *A. regia* in being proportionately narrower laterally and less expanded anteriorly.

Mesón, Salitre Ranch, Mexico; Cummins and Sands, collectors, 1909; California Academy of Sciences, locality X 24, two specimens.

#### Genus SCHIZASTER Agassiz

##### SCHIZASTER CRISTATUS Jackson

*Schizaster cristatus* JACKSON, Proc. U. S. Nat. Mus., vol. 53, p. 499, pl. 68, figs. 2-4, 1917.

*S. cristatus* differs from *S. dumblei* Israelsky<sup>9</sup> in being more compressed laterally and more highly carinate posteriorly.

The species *cristatus*, described from Brazil, Costa Rica, is represented by a number of excellent specimens from Mexico:

Oligocene, Mesón, localities: Horizon "M", Transcontinental Railroad, lot 145 Hacienda Chinampa, 8 km east of the town of Chinampa, Canton Tuxpan, Veracruz; also in lot 214, Hacienda Chinampa, D. R. Semmes, collector, June 1920, one specimen; station 49, Transcontinental Railroad, east of construction camp, just below large *Lepidocyclina* bed, D. R. Semmes, 1920, one specimen; Huasteca Railroad cut, Km 10, Hacienda San Miguel, 7.5 km south of Dos Bocas Crater, Canton Ozuluama, Veracruz, Dr. T. W. Vaughan, collector, 1920, one specimen.

Miocene: Quarry, Tuxpan, Mexico, D. R. Semmes, collector, no. 77, U.S.N.M., two specimens.

#### Family SPATANGIDAE Gray

##### Genus EUPATAGUS Agassiz

##### EUPATAGUS MEXICANUS, new species

##### PLATE 14; PLATE 15, FIGURE 1

Test massive, elongate, ovate, high, rounded, dome-shaped, truncate anteriorly, elongate-ovate posteriorly. Steeply rounded from the apical disk to the anterior border of the test. Ventrally nearly flat except the plastron, which is strongly elevated. The anterior furrow is lacking except for a moderate depression ventrally close to the peristome. The paired ambulacra are flush, wide, petaloid, the anterior pair II and IV curving somewhat forward. The anterior

<sup>8</sup> Proc. California Acad. Sci., ser. 4, vol. 13, p. 142, 1924.

<sup>9</sup> Proc. California Acad. Sci., ser. 4, vol. 13, p. 141, 1924. The species *dumblei* was figured as *Schizaster scherzeri* Gabb by Kew, Proc. California Acad. Sci., ser. 4, vol. 7, no. 5, pl. 18, fig. 2, pl. 19, fig. 2, and pl. 20, fig. 2, 1917.

ambulacrum III is narrow, straight, inconspicuous, but widening as it approaches the peristome. The posterior pair of ambulacra I and V extend backward in almost a straight line and are widely divergent from the anterior pair. The pores of the paired ambulacra are dorsally very much alike, the inner pores being rounder and the outer pores elongate. The interambulacra are very wide and are highly rounded in the medium line. Dorsally there are numerous perforate primary tubercles, widely spaced with secondary tubercles and miliaries between them. Ventrally the primary tubercles are larger, more crowded, and with numerous smaller tubercles between them. In the best-preserved specimen the peripetalous fasciole is in part visible. The apical disk is small, with five small ocular and four small genital plates situated at the highest point of the test, which is eccentric anteriorly. The periproct is large, situated posteriorly and just not visible in dorsal view, clearly visible on the posterior slope when viewed ventrally. The peristome is large, situated far anteriorly. The plastron is prominent, elongate, elevated, and relatively narrow.

The holotype (U.S.N.M. no. 496281), which is the smallest of the three known specimens, is selected as such because it is the most perfectly preserved. It measures 127 mm in length, 116 mm in width, and 58 mm in height; the distance from the center of the apical disk to the anterior margin is 27 mm (pl. 14 is slightly foreshortened). The largest specimen measures 152 mm in length, 139 mm in width, and 71 mm in height. This magnificent species is represented by three specimens in remarkably perfect condition of preservation. The tests are not at all compressed or distorted and show surface characters exceptionally well, especially the smallest one of the three.

*E. mexicanus* approaches nearest to *E. vaughani* Jackson,<sup>10</sup> from the Oligocene of Antigua, West Indies. It differs from *vaughani* in being higher and more steeply rounded anteriorly, in outline more truncate anteriorly, and more elongate-ovate posteriorly. In *mexicanus* the peristome is situated farther anteriorly, and the plastron is narrower and less elevated posteriorly than in *vaughani*.

Lambert (*op. cit.*) records a specimen of *E. vaughani* under the name *Antillaster vaughani* (Jackson) from near Topilla. His specimen, as stated and figured, is incompletely preserved, and it is quite possible that it may be referable to the new species *E. mexicanus*.

Mesón formation, former Corona camp site, at southern end of Cerro La Puerta, Hacienda Santa Fé, Topila, Canton Ozuluama, Veracruz; Corona collection, three specimens, nos. 1-3.

<sup>10</sup> Carnegie Inst. Washington Publ. 806, p. 96, pl. 17, fig. 2; pl. 18, figs. 1, 2, 1922.

## Genus LOVENIA Desor

## LOVENIA DUMBLEI Kew

*Lovenia dumblei* Kew, Proc. California Acad. Sci., ser. 4, vol. 7, p. 136, pl. 17, figs. 2a-c, 1917.—ISRAELSKY, Proc. California Acad. Sci., ser. 4, vol. 13, p. 145, 1924.

The genus *Lovenia* is not recorded by Clark and Twitchell as occurring in the United States, and so far as known it is thus far found in America only in Mexico. Lambert (*op. cit.*) describes as a new species *Vasconaster jeanneti* from near Tuxpan, Mexico. This type is nearly allied to *Lovenia*.

A number of fine specimens of *L. dumblei* occur in the collection from several localities of Oligocene age in Mexico:

Transcontinental Railroad, a little east of Km 5, lot 214 Hacienda Chinampa, 10 km east of the town of Chinampa, Canton Tuxpan, Veracruz, from main *Lepidocyclus* *gigas* bed, Mesón formation, collected by Vaughan, Weaver, and Semmes, 1920, three specimens, no. M.30V; another specimen was collected from the same locality by the same geologists but just above the *Lepidocyclus* *gigas* bed, no. M.29V; station 49, Transcontinental Railroad, east of construction camp, Mesón formation just below large *Lepidocyclus* bed, D. R. Semmes, collector, one specimen, no. 57. Vaughan and Semmes collected from the Eocene, probably the Tantoyuca formation, on Arroyo Zarco, south side of Peregrina Hill, Hacienda Tamemaz, 9 km southeast of the town of Tempoal, Veracruz, north of road from El Cristo to Dos Caminos, Mexico, from just above the *Venericardia* bed (M.110b V), several fragments of a species of *Lovenia* that resemble *L. dumblei* Kew.

## LOVENIA MEXICANA, new species

## PLATE 15, FIGURES 2, 3

Test low, cordiform, elongate, truncate anteriorly with a moderately deep anterior furrow, ovately elongate posteriorly. Nearly flat dorsally, flattened and moderately reentrant about the peristome ventrally. Anterior ambulacrum III narrow, inconspicuous in the moderately deep anterior furrow. Paired ambulacra slightly sunken dorsally, wide, triangular near the apical disk; they narrow toward the ambitus. Interambulacra broad, rounded, bearing dorsally rather small perforate primary tubercles, widely spaced, with secondary and miliary tubercles. There are a number of primary tubercles on the posterior interambulacrum 5, as well as on the other four interambulacral areas. Ventrally the primary tubercles are more crowded. Neither the internal fasciole nor the subanal fasciole could be made out in either specimen, though these characters are quite clear in some of the specimens of *L. dumblei*. In *L. mexicana* the apical disk

is small, situated a little posterior to the center of the test. Peristome transversely oval, situated on the posterior face, just not visible in dorsal view. Peristome wide, sunken, near the anterior border. Plastron very narrow, highly elevated into a rostrum, near the labrum in the center line.

There are two specimens of this new species, the smaller, which is more perfectly preserved, being selected as the holotype (in museum of California Academy of Sciences). It measures 49 mm in length, 45 mm in width, and 15 mm in height. The larger specimen, which is less well preserved in surface characters yet undoubtedly the same species, measures 65 mm in length, 58 mm in width, and 21 mm in height. *L. mexicana* differs from *L. dumblei* in having the posterior interambulacrum 5 carinate. The apical disk is posterior to the center instead of anterior, the primary tubercles are smaller and occur on interambulacrum 5 as well as other interambulacral areas, whereas they are lacking in area 5 in *dumblei*. In *mexicana* the plastron is narrower and at the same time more strongly keeled than in *dumblei*.

Mesón formation, Rancho Nuevo, 2.5 km west-southwest of Mesón, Canton Tuxpan, Veracruz, Mexico, a few miles northeast of Tepezintla, between Mesón and Cerro Azul, Veracruz; W. F. Cummins, collector, two specimens, California Academy of Sciences, locality X 62.







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## TWO NEW BEETLES OF THE FAMILY MORDELLIDAE FROM ORCHIDS

By EUGENE RAY

THE descriptions of mordellid beetles herein make available for reference the names of two new species of *Mordellistena* taken in the leaves of orchids. A previously described species (*M. cattleyana* Champion<sup>1</sup>) has been collected from the flower of *Cattleya* sp. The present paper extends the known habitat of the genus to include the orchid genera *Epidendrum* and *Catilloa*.

### Genus MORDELLISTENA Costa

#### MORDELLISTENA EPIDENDRANA, new species

This species may be separated from *cattleyana* Champion by the absence of the two transverse, fuscous, elytral fasciae, the broader terminal segment of the maxillary palpi, and the different number of ridgelike rows of short black setae on the posterior tibiae and tarsi.

Length: 2.5 mm: including anal style, 3.2 mm. Elongate, sub-parallel. Derm bicolored; head piceocastaneous (a narrow line along occiput and a broad circular area along front fuscocastaneous in female); pronotum flavocastaneous; a vague cloud visible in some specimens at center of base; scutellum fuscopiceous; elytra castaneous, with suture and lateral margins narrowly fuscous—in the male the fuscous coloration includes the entire apical half of

<sup>1</sup> Ent. Monthly Mag. vol 49, p. 56 March 1913.

elytra; ventral surface flavocastaneous (castaneous in male), side pieces of mesosternum darker; anal style fuscous (piceous in male); apical setae and ridges of legs piceous; antennal segments fuscocastaneous. Body densely covered with fine, recumbent, flavocinereous pubescence.

Antennae 0.5 mm long, reaching posterior coxae; segments 1 and 2 equal; 3 and 4 equal, each one-third shorter than 2; 5-10 equal in length, each as long as 3 and 4 together, strongly convex on mesal margin; 11 one-fourth longer than 10, rounded, attenuate to apex. Apical segment of maxillary palpus enlarged, broadly scalene-triangular, sides slightly curved, corners rounded. Prothorax slightly broader than long, sides rounded, basal angles acute, base arcuate, midbasal lobe short, rounded. Scutellum small, triangular. Elytra two and one-half times as long as broad, sides subparallel, apical third strongly curved, apices individually rounded. Posterior tibiae with two equal oblique ridges extending halfway across outer face; posterior basitarsus with two, second segment with two oblique ridges. Anal style more than two and one-half times as long as apical ventral segment, moderately slender, evenly attenuate, truncate at apex.

*Type locality*.—Dominican Republic.

*Type*.—Male, U.S.N.M. no. 51950.

*Remarks*.—Four specimens, one male, three females, are at hand. All were secured in *Epidendrum* sp. from the Dominican Republic on September 10, 1936, at San Francisco, Calif., the port of entry. As noted above, the only differences between the sexes is the generally darker color of the male.

#### MORDELLISTENA CHAPINI, new species

This species may be separated from both *cattleyana* Champion and *epidendrana*, described above, by the peculiar coloration of the derm and pubescence on the elytra, the different color combinations of the entire body, the club-shaped terminal segment of the maxillary palpi, the single ridge on the second segment of the posterior tarsi, the slenderer, peculiar antennae, and the smaller size.

Length: 2.2 mm; including anal style. 2.7 mm. Elongate, subparallel. Derm bicolored: head and pronotum fuscocastaneous, the latter with a mediodorsal cloud; humeri of elytra with a broad, circular, humeral spot, extending one-fourth entire length, not touching suture; anterior and intermediate legs flavous, antennae, maxillary palpi, and posterior legs fuscoflavous. Body densely covered with fine, recumbent pubescence, partaking of ground color, except on elytra, where there occurs postmedially a broad, transverse, arcuate band (broadest anteriorly at suture) and a large apical area covering apical sixth.

Antennae 0.4 mm long, reaching posterior coxae; segments 1 and 2 equal; 4 distinctly longer than 3; 5-10 each one-half longer than 4, subfiliform, slender; 11 longer than 10, rounded, attenuate to apex. Apical segment of maxillary palpus enlarged, club-shaped, broadest subapically, mesal margin strongly curved, lateral margin straight, apex abruptly rounded. Prothorax broader than long, sides rounded, basal angles right angles, base arcuate, midbasal lobe short, rounded. Elytra more than two and one-half times as long as broad, sides subparallel, apical third strongly curved, apices individually rounded. Posterior tibiae with two equal, oblique ridges extending halfway across outer face; posterior basitarsus with two, second segment with one oblique ridge. Anal style two and one-half times as long as apical ventral segment, slender, evenly attenuate to apex.

*Type locality*.—Venezuela.

*Type*.—Male, U.S.N.M. no. 51951.

*Remarks*.—Two specimens, both males, are at hand. The type emerged from a leaf of *Cattleya* sp. from Venezuela, on May 15, 1936, at Washington, D. C., in quarantine. The paratype was taken as a leaf miner in *Cailloua* sp. from Brazil and emerged on August 11, 1936. The latter specimen bears the provisional determination label of *Mordellistena cattleyana* (?) Champion but is undoubtedly identical with the type of *chapini*. This species is named for Dr. Edward A. Chapin, of the Smithsonian Institution.





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# REVISION OF THE NORTH AMERICAN SPECIES OF ICHNEUMON-FLIES OF THE GENUS EXETASTES GRAV- ENHORST

By R. A. CUSHMAN

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Agriculture*

THIS paper is a revision of the known species of *Exetastes* of North America north of Mexico. Thirty-five names of North American species have been used in combination with *Exetastes* or represent species belonging to the genus. One of these is a *nomen nudum*. Elimination of those erroneously referred to the genus and the *nomen nudum* and the synonymizing of others leave 21 properly referable to *Exetastes*. Of these I find two names preoccupied, for which I propose substitute names. Three of the 21 I consider to represent varieties of a fourth. The status of each of the 35 names is discussed on later pages. To the 18 species and 3 varieties 38 new species and 1 new variety are added in the present revision.

## HISTORY

Aside from the description of species, the genus *Exetastes* has received rather scant attention from North American taxonomists. The only keys published are that of Provancher to eight Canadian species and that of Viereck to three Connecticut species.

In 1828 Say described *Ichneumon bifasciatus* and in 1836 *Banchus nervulus*, both of which were transferred to *Exetastes* in 1921 by Cushman and Gahan.

Cresson, usually interpreting the genus correctly, described 15 species: *abdominalis*, *affinis*, *caeruleus*, *consimilis*, *decoloratus*, *fascipennis*, *flavipennis*, *flavitaris*, *niger*, *obscurus*, *rufipes*, and *scutellaris*, all from Colorado, in 1865; *bioculatus*, from Texas, in 1872; and *maurus* and *zelotypus*, from California, in 1878. Finding *maurus* and *flavitaris* preoccupied, Dalla Torre (1901) renamed them *deutero-maurus* and *cressonii*, respectively.

In 1873 Walsh described *Exetastes suaveolens* and *Leptobatus illinoisensis*. The latter was transferred to *Exetastes* by Cresson in 1877.

In 1874 Provancher described *rufus* and *albitarsis*, later transferring *rufus* to *Ceratosoma*, under which genus, renamed *Ceratogastra* by Ashmead, it stands in Dalla Torre's "Catalogus Hymenopterorum"; in 1877, *rufofemoratus*; in 1879, *brevipennis*, *clavatus*, and *matricis*, later synonymizing *brevipennis* with *Mesostenus promptus* Cresson; and in 1883, *Campoplex niger*, the involved nomenclatorial relationship of which to *Exetastes* will be discussed in detail under *suaveolens* Walsh. Into this nomenclatorial tangle, because of the obvious mislabeling of a specimen of *suaveolens* as *Campoplex niger* Provancher, comes *Exetastes provancheri* Dalla Torre (1901), a name proposed to replace the preoccupied combination *Exetastes niger* (Provancher). In 1886 Provancher published *Banchus caudatus*, which Davis (1894) properly transferred to *Exetastes*. A misidentification by Provancher of *Arenetra rufipes* Cresson as *Exetastes niger* Cresson, later corrected by Provancher himself, brings *A. rufipes* into the nomenclatorial picture as the third species to be mentioned under the name *Exetastes niger*.

In 1898 Davis described his *Exetastes abbreviatus*, *E. exploratus*, and *Rhimphalea brevicorpa*, the last of which I find synonymous with one of Cresson's species of *Exetastes*.

In 1910 Viereck published the *nomen nudum*, *Exetastes propinquus* Cresson.

#### SPECIES ERRONEOUSLY REFERRED TO EXETASTES

(*EXETASTES ABBREVIATUS* Davis) = *XENOSCHESIS CINCTIVENTRIS* (Ashmead), new combination

*Colpotrochia? cinctiventris* ASHMEAD, Trans. Amer. Ent. Soc., vol. 23, p. 200, 1896; male (not female as given in description).

*Homobia cinctiventris* (Ashmead) DAVIS, Trans. Amer. Ent. Soc., vol. 24, p. 278, 1897; male (not female).

*Exetastes abbreviatus* DAVIS, Trans. Amer. Ent. Soc., vol. 24, p. 366, 1898; male. New synonymy.

*Xenoschesis slossonae* CUSHMAN, Proc. Ent. Soc. Washington, vol. 17, p. 140, 1915; female. New synonymy.

(*EXETASTES BREVIPENNIS* Provancher) = *MESOSTENUS PROMPTUS* Cresson

I have already discussed this synonymy (Proc. U. S. Nat. Mus., vol. 74, art. 16, p. 46, 1929).

(*EXETASTES CLAVATUS* Provancher) = *EURYPROCTUS CLAVATUS* (Provancher), new combination

Neither Davis nor Rohwer and Gahan could find the type of this species in the Provancher collection, but I have been able to recognize it in a species closely related to *Euryproctus petiolatus* Davis. A specimen in the United States National Museum agrees almost perfectly with the original description, and I have identified it as *clavatus*.

(*EXETASTES CONSIMILIS* Cresson) = *LISSONOTA CONSIMILIS* (Cresson), new combination

This species is based on a male closely related to *Lissonota americana* (Cresson).

(*EXETASTES NIGER* Provancher, not Cresson) = *ARENETRA RUFIPES* Cresson

Provancher misidentified as *Exetastes niger* Cresson a female specimen, which he later identified as *Arenetra rufipes* Cresson. Dalla Torre, mistaking Provancher's intention, synonymized *Exetastes niger* Cresson female (not male) with *Arenetra rufipes* Cresson. In this he was in error, for *niger* is an *Exetastes*, and the male and female described by Cresson are conspecific.

(*CAMPOPLEX NIGER* Provancher) = *CASINARIA GENUINA* (Norton)

Although this species, as represented by its type, has never really been placed in *Exetastes*, its name is involved with the genus because of the mislabeling of a specimen of *Exetastes suaveolens* Walsh, under which species the matter will be fully discussed.

(*EXETASTES RUFUS* Provancher) = *DYSPETES RUFUS* (Provancher)

I have already published this generic transfer (Proc. U. S. Nat. Mus., vol. 72, art. 13, p. 21, 1927).

#### HOST RELATIONS

So far as species of *Exetastes* have been reared they are internal parasites of lepidopterous larvae. The full-grown larva leaves its host before spinning its cocoon. The only recorded exception to this host relation is that of *Exetastes cimbicis* Vollenhoven<sup>1</sup> from Holland, which is said to be parasitic on the sawfly *Cimbex aenea* (Fabricius).

Among the Lepidoptera the favored hosts appear to be Noctuidae, especially those of the type known as "cutworms." Records of the rearing of species of *Exetastes* from such hosts as Tortricidae and Pyralidae and perhaps those in other groups, several of which have been published, mostly of European species, seem most likely to be errors of identification either of the host or of the parasite, for in nearly every case the species of *Exetastes* involved is known as a parasite of some noctuid. Probably for the reason that the hosts have been reared only sparingly there are comparatively few rearing records in

<sup>1</sup> I have been unable to secure the original description of this species, but I suspect that it is a species of *Xenoschesis* or of some allied tryphonine genus.



American literature; but that the group must be of considerable economic importance is indicated by the abundance of certain of the species such as *matricus* Provancher, *rufofemoratus* Provancher, *suaveolens* Walsh, *obscurus* Cresson, and others. Such host records of North American species as are known are given in the discussion of the species.

#### MATERIAL STUDIED

Through the kindness of the Academy of Natural Sciences of Philadelphia, I have had access to the types of all Cresson's and Davis' species and to other material in the Academy. The types of Provancher's species, with the exception of *clavatus*, have been examined by my associates A. B. Gahan and C. F. W. Muesebeck, and specimens compared by them with these types are in the National Museum. The types of Say's two species and Walsh's two are no longer in existence, but specimens of Say's species identified by Gahan and myself and of Walsh's easily recognized species are also in the United States National Museum.

In addition to nearly 400 specimens in the National Museum I have had for study about 300 specimens lent to me by the following institutions and individuals: California Academy of Sciences, University of Arizona, Texas Agricultural Experiment Station, Kansas University, Colorado Agricultural College, Canadian National Collection, Cornell University, American Museum of Natural History (New York); Connecticut State Experiment Station (New Haven); Boston Society of Natural History; P. W. Fattig, of Emory University, Atlanta, Ga.; Frank D. DeGant, of Cleveland, Ohio; Andrew R. Park, of Springfield, Ill.; and Henry K. Townes, of Cornell University.

To all these institutions and individuals I wish to extend my thanks.

#### Genus *EXETASTES* Gravenhorst

*Exetastes* GRAVENHORST, *Ichneumonologia Europaea*, vol. 3, p. 395, 1829. (Genotype, *Ichneumon fornicator* Fabricius.)

*Leptobatus* GRAVENHORST, *Ichneumonologia Europaea*, vol. 3, p. 432, 1829. (Genotype, *Leptobatus zieglerei* Gravenhorst.)

*Rhimphalea* DAVIS, not Foerster, *Trans. Amer. Ent. Soc.*, vol. 24, p. 274, 1897. (Genotype, *Rhimphalea brevicorpa* Davis.)

Mostly rather large insects (7–15 mm), conforming to the following description:

Head from above transverse; never strongly swollen, though with the temples sometimes strongly convex; face flat or convex, usually with a median elevation; clypeus divided into basal and apical portions by elevation of basal portion, by impression of apical portion, or by marked difference in sculpture and frequently also by difference in color, arcuate or truncate at apex and frequently with a median apical groove or narrow emargination; mandibles distinctly bidentate,

the teeth not of very different size; palpi slender, with no markedly enlarged or compressed joints; labium never greatly elongated; antenna filiform or slightly thickened near middle and tapering toward both base and apex, scape obliquely truncate, basal joints of flagellum much longer than second joint; eyes not emarginate; ocelli not touching the eyes, rarely very large; malar space distinct.

Thorax more or less compressed; notauli and sternaui weak or absent; prepectal carina distinct; scutellum moderately elevated, propodeum not areolated, at most with apical carina distinct, spiracles oval to elongate.

Hind leg very much longer than others, coxa very large, calcaria long.

Wings large; stigma and radial cell narrow; areolet trapezoidal with second intercubitus frequently curved and second recurrent at or near middle, usually large and sessile or shortly petiolate, rarely small and with long petiole; discocubitus curved or broken, in the latter case frequently with a short ramellus; second recurrent from nearly straight to strongly bisubgeniculate, bullae confluent or very narrowly separated; nervulus postfurcal; postnervulus broken well below middle; nervellus broken near top and strongly reclivous.

Abdomen fusiform, in female usually more or less compressed apically, hypopygium nearly or quite reaching apex; first segment subsessile to subpetiolate, usually strongly convex above just before spiracles, spiracles at or before middle; ovipositor with a distinct subapical notch dorsally, compressed, straight or curved, usually prominently exerted, sheath rarely as long as abdomen or longer, very rarely barely exerted.

As thus characterized and as represented in the North American fauna, the genus is composed of several more or less well defined groups of species, some of which could be separated as easily recognizable genera; but if this were done there would still be left a more or less heterogeneous residue, composed of a majority of the species. I believe the convenience and aims of classification are better served by the preservation of one large, easily defined, and easily recognized genus than by the erection of a series of small genera with the original genus left as a catch-all of species that can not be placed elsewhere.

Of all the characters ascribed by various writers to *Leptobatus* only one, the long ovipositor, distinguishes it from *Exetastes* as heretofore constituted, and this can not be accepted as a generic character.

*Rhimphalea brevicorpa* Davis, a synonym of *Exetastes bioculatus* Cresson, was the first species assigned to *Rhimphalea* Foerster, and was recognized by Viereck as the genotype. In my opinion it can not be accepted as such, since it will not run to Foerster's family Tryphonoidae because of the lack of dorsal carinae or groove on the first abdominal segment.

*Systematic relationships.*—The affinities of *Exetastes* and its closest allies are, in my opinion, on the one hand with the Lissonotini, especially with such genera as *Arenetra* Holmgren, *Alloplasta* Foerster, *Echthrodoca* Schmiedeknecht, *Cryptopimpla* Taschenberg, and *Lampronota* Curtis, and on the other hand with *Banchus* Fabricius and its allies.

Of all the characters listed in the above description only one will, by itself, distinguish *Exetastes* from all the genera known to me that are at present assigned to the Lissonotini. This is the fracture of the nervellus far above the middle. Even the other most striking characteristic of the genus, that of habitus, is approached rather closely by *Cryptopimpla*, *Echthrodoca*, and *Arenetra* and even more closely by certain tropical genera such as *Stictolissonota* Cameron.

The relationship of *Exetastes* and its allies to the typical Banchini is distinctly more remote, although the only known characters exhibited by all true Banchini that are not duplicated in the *Exetastes* group are the broad upper tooth of the mandible and the form of the apex of the abdomen in the female.

The correct position of these two groups of genera has long been a matter of disagreement. Most writers have followed the traditional placing in the subfamily Ophioninae and have treated them as belonging to a single tribe, the Banchini. More recently some writers have transferred the tribe Banchini to the subfamily (Pimplinae) Ichneumoninae, some being inclined to divide the tribe into the Banchini and Exetastini. In my opinion the tribe Exetastini is not sufficiently distinct to justify its separation from the Lissonotini (with which Seyrig has correctly combined the Glyptini). The genera comprised in this group are *Exetastes* Gravenhorst, *Allexetastes* Kokujev, *Tetractenion* Seyrig, *Tegona* Morley, *Agathilla* Westwood (= *Agathobanchus* Ashmead), and *Rhynchetastes* Cameron.

*Banchus* and its allies, *Nawaia* Ashmead (probably synonymous with *Banchus*), *Rhynchobanchus* Kriechbaumer, *Cercatogastra* Ashmead, *Banchoides* Dalla Torre, and the apparently synonymous *Eponites* Cameron, I consider to form a sufficiently homogeneous and distinct group to maintain as the tribe Banchini.

Of the other genera assigned to the Banchini by more recent writers *Leptobatopsis* Ashmead has been referred by me to the Lissonotini, where *Fintona* Cameron also evidently belongs; *Baliene* Cameron has been synonymized by Morley with *Pseudeugalta* Ashmead; *Xenoschesis* Foerster belongs to the mesoleptine subtribe Notopygina; *Aethria* Tosqinet appears from the description to be synonymous with *Eugalta* Cameron; *Lapton* Nees and *Allotheca* Cameron are unknown to me, and *Ithagenes* Foerster as yet contains no species.

KEY TO NORTH AMERICAN SPECIES OF *EXETASTES*

The following key to the North American species of *Exetastes* embodies an attempt to classify the species in natural groups. This has necessitated rather long couplets, but it is hoped that the result will prove more satisfactory than a purely artificial key. In these group definitions color has been employed only as a supplementary character. Within the groups color is more freely used since it frequently furnishes the most easily observable characters. Because of the uncertainty as to its proper position, *Exetastes caudatus* (Provancher) is omitted from the key.

1. A high thin carina between antennae; second discoidal cell very short, the second recurrent being nearly or quite as long as basal abscissa of subdiscoideus; areolet unusually small; apical carina of propodeum very strong.----- 2  
 No carina between antennae; second discoidal cell with recurrent much shorter than basal abscissa of subdiscoideus; areolet of normal size; apical carina rarely very strong.----- 4
2. Clypeus not obviously divided into basal and apical portions, the apical portion represented by a narrow, sharply inflexed margin; occipital carina reaching hypostomal carina; thorax very coarsely, densely, and evenly punctate; recurrent distinctly basad of middle of areolet; ovipositor sheath hardly half as long as first tergite.----- 1. *carinatifrons*, new species  
 Clypeus distinctly divided; occipital carina not reaching hypostomal carina; thorax less coarsely and densely punctate; recurrent at or very near middle of areolet; sheath nearly or quite as long as first tergite.----- 3
3. Temples in female receding at about 45° and nearly flat, less strongly sloping and more strongly convex in male; postocellar line hardly longer than ocellocular line and distinctly less than twice the diameter of lateral ocellus; antenna with 40 joints or less, subapical joints in female hardly longer than thick; wings yellowish infumate with apical fascia little darker.----- 2. *septum*, new species  
 Temples in female more strongly receding; postocellar line distinctly longer than ocellocular line and fully twice diameter of an ocellus; antenna with 46 joints, subapical joints distinctly elongate; wings nearly hyaline with apical fascia very distinct.----- 3. *carinatus*, new species
4. Head and thorax mat, extremely finely and densely punctate, with very dense, fine pubescence; eyes distinctly divergent below; abdomen very broad, first tergite triangular, about as broad as long, others transverse; black species with a distinctly grayish appearance due to the dense pubescence; all tergites broadly margined with yellow.----- 4. *lasius*, new species  
 More coarsely punctate and usually shining, with pubescence sparser and coarser; eyes at most very slightly divergent below; first tergite distinctly longer than broad; not so colored.----- 5
5. Clypeus narrow, divided into basal and apical portions only by slight difference in sculpture; apical carina of propodeum

- distinct, setting off a very short petiolar area; second recurrent vein nearly straight; abdomen barely longer than head and thorax, hardly compressed at apex; ovipositor sheath barely extending beyond apex of abdomen; very small species with head and thorax black, or black and ferruginous, with yellow markings, and abdomen largely red..... 6
- Clypeus usually broader and more distinctly divided; apical carina absent, or if more or less indicated it is farther from apex; recurrent vein usually distinctly flexed or curved; abdomen longer than head and thorax and, in female, more or less compressed at apex; sheath extending distinctly beyond apex of abdomen, sometimes very long..... 7
6. Propodeum and metapleurum largely or entirely ferruginous.  
6. *bioculatus* Cresson  
Propodeum and metapleurum black with apices broadly yellow.  
5. *pictus*, new species
7. Face broader than length of the unusually small eyes, flat with a prominent median rounded elevation; clypeus more than twice as broad as long, transversely divided close to base; second recurrent nearly straight; ovipositor recurved, sheath more than half as long as abdomen..... 8
- Face rarely as broad as length of eye; clypeus not more, usually much less, than twice as broad as long; recurrent usually more or less distinctly curved or flexed; ovipositor shorter..... 9
8. Mesoscutum immaculate; wings infumate..... 7. *ridens*, new species  
Mesoscutum with conspicuous yellow markings; wings hyaline.  
8. *illinoiensis* (Walsh)
9. Pale lemon yellow with small black or reddish markings; ocelli unusually large, their diameter in female at least nearly as long as ocellular line; malar space in female nearly as long as basal width of mandible; ovipositor long and recurved, sheath longer than first tergite; hind femur short and stout..... 10
- Black or ferruginous or both, rarely with yellow markings; ocelli very rarely so large; differing also by one or more of the other characters..... 11
10. Abdomen with black markings; ocellular line in female shorter than diameter of ocellus..... 9. *flavus*, new species  
Abdomen with pale reddish markings; ocellular line in female slightly longer than diameter of ocellus..... 10. *pallidus*, new species
11. Head very thick, with occiput shallowly concave, temples broad and very strongly convex; legs stout, hind femur not, or little, more than two-thirds as long as tibia; claws in female strongly pectinate (abdomen stout with first tergite much more than half as broad as long)..... 12
- Head not especially thick, occiput more deeply concave, temples at most moderately convex and strongly receding; hind femur relatively longer; claws usually simple..... 17
12. Clypeus with apical portion abruptly impressed below level of basal portion, the basal portion forming a strong transverse ridge; malar space in female barely, in male less than, half as long as basal width of mandible; wings in both sexes distinctly infumate; ovipositor straight, sheath not longer than first tergite..... 13

- Clypeus with apical portion not so abruptly impressed (in doubtful cases the wings are hyaline and the ovipositor much longer and curved); malar space in both sexes usually more than half as long as basal width of mandible (in the lone exception the clypeus is notably flat and the thorax is black and yellow); ovipositor curved, sheath nearly or quite as long as first two tergites.....14
13. Hind tibia and basitarsus not at all darkened; wings deeply infumate with stigma dark ferruginous; sheath much shorter than first tergite.....11. *propinquus*, new species  
Hind tibia at apex and basitarsus blackish; wings yellowish infumate with stigma pale yellowish ferruginous; ovipositor sheath subequal to first tergite.....12. *scutellaris* Cresson
14. Head and thorax black and yellow, not at all ferruginous; wings deep flavous with apices infumate.....13. *igneipennis*, new species  
Thorax and usually head largely or conspicuously ferruginous, this color sometimes largely replaced by black in male; wings uniformly infumate or subhyaline.....15
15. Temple reaching outside tangent of eye; eyes hardly as long as width of face, faintly divergent below; head of male black and yellow, not at all red.....14. *buccatus*, new species  
Temple not reaching outside tangent of eye; eyes fully as long as width of face, parallel or faintly convergent; head of male more or less reddish.....16
16. Flagellum entirely black; hind femur and tibia not at all black apically.....15. *pectinatus*, new species  
Flagellum largely ferruginous; hind femur and tibia blackish apically.....16. *brevicornis*, new species
17. Head and thorax finely and very densely punctate, dull; clypeal suture deep and straight between the foveae; clypeus rather broad, strongly divided into apical and basal portions, the basal portion very short; face fully as broad as length of eye, nearly flat with a median rounded elevation; eyes parallel; antenna in female very short, subapical joints transverse; legs slender, inner hind calcarium hardly half as long as basitarsus; ovipositor recurved, sheath about as long as first tergite; largely ferruginous, the male with head and thorax conspicuously black marked, sometimes almost entirely black.....18  
Differing in all or most of the above characters.....19
18. Wings in female distinctly fasciate; stigma pale, at base, dark at apex; malar space in female distinctly shorter than basal width of mandible, in male barely half as long; antenna with about 45 joints.....17. *bifenestratus*, new name  
Wings at most with faint traces of fasciae; stigma uniformly ferruginous; malar space in female subequal to basal width of mandible, in male distinctly more than half as long; antenna with about 50 joints.....18. *obscurus* Cresson
19. Mandible long with lower tooth larger and longer than upper tooth; clypeus large, two-thirds as long as broad, weakly convex and separated into nearly equal basal and apical portions only by difference in sculpture; antenna with less than 45 joints, hardly two-thirds as long as body, stout, with middle joints fully as thick as long, first joint of flagellum

- fully four times as long as thick and twice as long as second; eyes longer than width of face, slightly convergent; temples rather broad and strongly convex, but much shorter than short diameter of eye; ferruginous, the female with fasciate wings (male unknown); ovipositor straight, sheath three-fourths as long as first segment-----19. *callipterus*, new species
- Mandibles, clypeus, and antennae of different conformation; differing also by some or all of the other characters above-----20
20. Thorax, especially the pleura, very coarsely and densely punctate; mesopleurum slightly concave below and meeting the weakly convex sternum in a distinct rounded edge; propodeum sloping from near base, reticulate rugose and with a distinct median groove or a longitudinally rugose area; occipital carina not reaching hypostomal carina (ovipositor sheath not or barely half as long as first tergite; large, slender species with head and thorax black, abdomen and sometimes mesoscutum ferruginous)-----21
- Thorax more finely and usually less densely punctate; mesopleurum and mesosternum less definitely separated; propodeum more strongly rounded and usually less coarsely sculptured; occipital carina reaching hypostomal carina-----23
21. Mesoscutum largely or entirely ferruginous-----22
- Mesoscutum black-----22. *concurvus*, new species
22. Hind coxa partly and femur and abdomen entirely ferruginous. 20. *crassisculptus*, new species
- Hind coxa entirely and femur except base black; abdomen usually more or less black apically-----21. *rugosus*, new name
23. Scutellum more or less distinctly flattened on top, distinctly margined laterally at least toward base, apex precipitous (in doubtful cases agreeing with all the following characters); eyes large, at least as long as greatest width of face, convergent below; clypeus weakly separated from face and weakly divided transversely, long with more or less distinct apical emargination and usually with a short median groove; malar space much more than half as long as basal width of mandible; propodeum with distinct trace of apical carina medially; ovipositor straight, sheath not or barely as long as first tergite; black with abdomen concolorous or ferruginous, head and thorax sometimes with metallic reflections-----24
- Scutellum not flattened above and not margined; differing also by some of or all the other characters above-----31
24. Hypostomal carina very high and thin and flanked by a deep concavity, lower extremity of occipital carina distant from base of mandible more than width of latter-----25
- Hypostomal carina normal, lower extremity of occipital carina closer to base of mandible-----27
25. Hind femur red; hypostomal carina exceedingly high and strongly arched outward-----26
- Hind femur black; hypostomal carina lower and less strongly arched-----25. *abdominalis* Cresson
26. Wings subhyaline-----23. *matricus* Provancher
- Wings deeply infumate-----24. *infumatus*, new species
27. Abdomen black-----28
- Abdomen red (head and thorax with metallic reflections)-----30

28. With distinct metallic reflections.....26. *caeruleus* Cresson  
Without metallic reflections.....29
29. Malar space in female fully, in male nearly, as long as basal width of mandible; hind tarsus entirely red.....27. *alticola*, new species  
Malar space in female distinctly, in male much, shorter than basal width of mandible; hind tarsus with basal two joints fuscous.....28. *dilutipes*, new species
30. Front and middle legs, especially the latter, largely or entirely black or fuscous.....29. *purpureus*, new species  
Front and middle legs beyond trochanters, except middle tarsus, entirely red.....30. *rufipes* Cresson
31. Clypeus small, weakly convex in profile and almost without trace of transverse division; mandible short, nearly or quite two-thirds as broad at base as long; malar space much shorter than basal width of mandible; eyes convergent below, rarely parallel; antenna nearly as long as body, very slender, attenuate at apex; abdomen slender, first tergite nearly or quite three times as long as broad at apex; ovipositor sheath not or barely half as long as first tergite.....32  
Clypeus with at least a distinct trace of transverse division; mandible usually distinctly longer; first tergite relatively broader; disagreeing also with some of or all the other characters above.....37
32. Head and thorax conspicuously ornamented with yellow; propodeum in female partly ferruginous, in male broadly yellow at apex; antenna with white annulus.....31. *ornatus*, new species  
Head and thorax immaculate black, in male face and sometimes small markings on thorax yellow, but propodeum immaculate; antenna without annulus.....33
33. Notauli weakly indicated by very broad shallow impressions.....34  
Notauli not at all indicated.....35
34. Abdomen black.....32. *subimpressus*, new species  
Abdomen largely ferruginous.....33. *nigribasis*, new species
35. Abdomen ferruginous in middle.....34. *rufobalteatus*, new species  
Abdomen entirely black.....36
36. Legs largely black.....35. *angustus*, new species  
Legs largely ferruginous.....36. *convergens*, new species
37. Mouth very narrow; malar space long, cheeks in front view slightly but distinctly concave; clypeus long, strongly convex basally, especially in middle; propodeum with apical carina more or less distinct; ovipositor recurved; ferruginous, male with head and sometimes the thorax largely black with yellow markings (female with fasciate wings).....38  
Not entirely as above structurally; head and thorax not at all ferruginous.....39
38. Malar space fully as long as basal width of mandible.  
37. *angustoralis*, new species  
Malar space shorter than basal width of mandible.....38. *fascipennis* Cresson
39. Ocellocular line not or barely longer than diameter of an ocellus and little more than half as long as postocellar line; first tergite distinctly constricted before spiracles; nervulus antefurcal or interstitial (head and thorax black; abdomen and legs, including coxae, ferruginous).....39. *ruficoxalis*, new species



- Ocellocular line much longer than diameter of an ocellus and nearly or quite as long as postocellar line; petiole not distinctly constricted; nervulus usually distinctly postfurcal..... 40
40. Antenna stout, much shorter than body, tapering but not attenuate at apex, basal joint of flagellum hardly four times as long as thick, middle joints nearly as thick as long; apical portion of clypeus shining, very faintly sculptured; claws in both sexes distinctly pectinate (ovipositor sheath fully half as long as first tergite; head and thorax immaculate black, abdomen usually ferruginous, rarely black)..... 41
- Antenna slender, nearly as long as body, attenuate at apex, basal joint of flagellum more than four times as long as thick; apical portion of clypeus usually dull; claws in female rarely even weakly pectinate, in male simple..... 44
41. Abdomen largely and hind femur usually ferruginous..... 42
- Abdomen and hind legs black..... 43. *coloradensis*, new species
42. Malar space hardly half as long as basal width of mandible; first tergite black only at extreme base..... 40. *zelotypus* Cresson
- Malar space distinctly more than half as long as basal width of mandible; first tergite largely or entirely black..... 43
43. Hind femur red; second tergite entirely red... 41. *erythrogaster*, new species
- Hind femur black, second tergite largely black... 42. *concoloripes*, new species
44. Malar space not or barely half as long as basal width of mandible; cheeks in front view convex; mouth distinctly broader than face; clypeus rather short and nearly as broad as face, with a strong, straight transverse ridge; temples strongly convex (ovipositor sheath not, or barely, half as long as first segment; black with abdomen red)..... 45
- Malar space distinctly more than half as long as basal width of mandible; cheeks in front view rarely convex; mouth hardly broader than width of face (if distinctly broader, the eyes are strongly convergent and the face is narrow); clypeus rarely strongly ridged and then much narrower than face; temples flat or weakly convex..... 46
45. Hind femur black..... 44. *affinis* Cresson
- Hind femur red..... 45. *alternatipes*, new species
46. Second recurrent vein nearly straight; face more than twice as broad as long and broader than length of the slightly convergent eyes; ocellocular line nearly three times as long as diameter of an ocellus; inner hind calcarium distinctly less than half as long as basitarsus; head and thorax with dense long erect hair; abdomen short and stout (body and legs black; wings dark)..... 46. *deuteromaurus* Dalla Torre
- Second recurrent strongly curved or flexed; face not or barely twice as broad as long and usually narrower than length of eye; ocellocular line at most a little more than twice as long as diameter of an ocellus; inner hind calcarium fully half as long as basitarsus; head and thorax not conspicuously hairy; abdomen not especially short and stout..... 47
47. Eyes parallel, barely as long as width of face; head in front view not constricted below eyes; extended angle of cheeks nearly a right angle; clypeus small and with a distinct transverse ridge; antenna in female with about 80, in male with 65 or

- more, joints; ovipositor sheath much more than half as long as first tergite (black, female with pale antennal annulus and red hind femur, male without annulus, but with front and middle legs also largely red)----- 47. *bituminosus*, new species
- Eyes more or less convergent, distinctly longer than width of face; head in front view usually constricted below eyes, extended angle of cheeks narrowly acute; clypeus large, convex at base but without a distinct ridge; antenna in both sexes with not more than 65 joints; sheath not or barely half as long as first tergite----- 48
48. Clypeus separated laterally by distinct groove between fovea and base of mandible; mandible strongly narrowed toward apex, much less than twice as long as broad at base; occiput little broader than vertex, temples very strongly receding and nearly flat----- 49
- Clypeus not distinctly separated laterally; mandible weakly narrowed toward apex, nearly or quite twice as long as broad at base; occiput distinctly broader than vertex, temples more strongly convex and less strongly receding----- 50
49. Abdomen ferruginous----- 48. *dichrous*, new species
- Abdomen black----- 49. *corvinus*, new species
50. Wings bright yellowish with apices dusky----- 50. *flavipennis* Cresson
- Wings uniformly infumate or subinfumate----- 51
51. Hind leg black or piceous, at most with tarsus reddish apically----- 52
- Hind leg distinctly more or less red or yellow; if femur black, the tarsus pale yellow----- 54
52. Diameter of lateral ocellus not or barely more than half as long as postocellar line; temples weakly convex; punctuation of thorax moderately coarse and only moderately dense----- 53
- Diameter of lateral ocellus much more than half as long as postocellar line; temples strongly convex; punctuation of thorax, especially of mesoscutum, finer and very dense.
53. *persimilis*, new species
53. Malar space two-thirds basal width of mandible; diameter of lateral ocellus fully half as long as postocellar line; antenna in female about 60-jointed, blackish throughout.
51. *anthracinus*, new species
- Malar space three-fourths basal width of mandible; diameter of lateral ocellus less than half as long as postocellar line; antenna in female about 55-jointed, apical half reddish.
52. *geminus*, new species
54. Hind tibia pale yellow; front and middle femora more or less black----- 54. *suaveolens* Walsh
- Hind tibia black; front and middle femora yellowish ferruginous----- 55. *nervulus* (Say)

## 1. EXETASTES CARINATIFRONS, new species

PLATE 16, FIGURE 1; PLATE 17, FIGURES 23, 34; PLATE 18, FIGURES 53, 64;  
 PLATE 19, FIGURE 78; PLATE 21, FIGURE 111

This and the next two species form a group distinct from the rest of the species in the medially carinate frons, very short second discoidal cell, and small areolet, and from most of the others in the

strong apical carina of propodeum. From a great majority of the species they differ also in habitus, the abdomen being unusually short and the hind legs unusually long. All three are ferruginous with fasciate wings.

*Female*.—Length 10 mm.

Head thin, temples very strongly receding and nearly flat, occiput shallowly concave; frons coarsely and densely punctate, medially impressed, a high carina between antennae; face densely punctate, impressed on each side and rather prominent medially; clypeus barely half as broad as face, strongly rounded and narrowly inflexed at apex, the basal portion rather densely and finely punctate; cheeks in front view straight, their extended angle slightly acute; malar space as long as basal width of mandible; mouth distinctly narrower than face, mandible nearly as broad at base as long, strongly narrowing toward apex; junction of occipital and hypostomal carinae distant from base of mandible by the width of the mandible; eyes slightly longer than width of face, subparallel, inner margins weakly concavely curved; diameter of a lateral ocellus much more than half postocellar line, latter equal to ocellocular line; antennae (incomplete) very slender, second joint of flagellum about three times as long as thick.

Thorax densely, coarsely punctate throughout; notauli weakly broadly impressed; scutellum elongate subtriangular, lateral areas more sparsely punctate; propodeum rather flat, punctured like thorax, with a short, strongly defined, impunctate petiolar area, pleural carina more or less distinct posteriorly, spiracles small, barely twice as long as broad.

Legs very slender; hind leg nearly twice as long as body, femur reaching fully half its length beyond abdomen, inner calcarium hardly reaching middle of basitarsus.

Wings: Radial cell very narrow, apical abscissa of radius weakly curved at base, twice as long as basal abscissa; areolet smaller than usual, with long petiole, second intercubitus strongly curved, recurrent distinctly before middle; second discoidal cell very short, second recurrent nearly as long as basal abscissa of subdiscoideus and weakly curved; nervulus strongly postfurcal; abscissula not much longer than intercubitella.

Abdomen barely longer than head and thorax, polished; first segment depressed, more than half as broad at apex as long, petiole much broader than thick; second tergite slightly longer than broad at base; segments beyond third strongly compressed; ovipositor short, straight, sheath barely half as long as first tergite, elongate oval.

Ferruginous; face, orbits, and lower part of head paler, orbits yellowish; narrow circles about ocelli and spots on occiput, prepectus, and metasternum black; hind tibia reddish piceous, base yellow;

tarsi yellow; front wing yellowish hyaline with a broad fuscous fascia basad of and another beyond stigma, the basal one darker; stigma and veins in the middle hyaline area yellowish, basal portion of longitudinal veins reddish; hind wing almost uniformly pale fuscous.

*Type locality*.—Sabino, Ariz.

*Type*.—U.S.N.M. no. 51794.

*Remarks*.—Three females, the type dated August 17, 1921; the others from Uvalde, Tex., September 1924, A. P. Dodd, and Tlahuילו, Durango, Mexico, A. Busck. All are in bad condition, none having a complete antenna or hind tarsus. The holotype is the best preserved of the three.

## 2. EXETASTES SEPTUM, new species

PLATE 16, FIGURE 2; PLATE 17, FIGURE 29; PLATE 18, FIGURE 51; PLATE 19, FIGURE 69; PLATE 20, FIGURES 85, 99; PLATE 21, FIGURE 113

Related to *carinatifrons* in the high interantennal carina, small petiolate areolet, short second discoidal cell, and distinct petiolar area, and differing from that species principally as follows:

*Female*.—Length 9 mm, antennae 7 mm.

Head thicker, with temples less strongly receding (about 45° to longitudinal axis of body); frons less coarsely punctate and nearly flat, clypeus with apical portion merely impressed, not inflexed, and only slightly shorter than basal portion; cheeks concave; malar space a little shorter than basal width of mandible; mouth as broad as face; occipital carina hardly reaching hypostomal carina, latter high and thin; eyes very faintly convergent below; antenna 38- to 40-jointed, rather stout, slightly tapering apically, second joint of flagellum hardly twice as long as thick.

Thorax less coarsely punctate, scutellum sparsely so; propodeum somewhat more convex, petiolar area longer, reaching to about apical third medially.

Legs shorter, hind femur hardly surpassing apex of abdomen.

Abdomen distinctly a little longer than head and thorax, stouter with first segment thicker and second not longer than broad at base ovipositor slender, slightly recurved, sheath about as long as first tergite.

Body and legs colored as in *carinatifrons*, but antennae blackish apically; wings less contrastingly colored, but with same color pattern; ovipositor sheath blackish.

*Male*.—Like female except that temples are broader and rather strongly convex; eyes a little smaller, the malar space consequently about as long as basal width of mandible.

Black markings larger; stemmaticum, spots on anterior margin of mesoscutum and upper margin of mesoscutum, lateral areas of scutellum and postscutellum, and meso-metathoracic suture also black.

*Host*.—*Catabena lineolata* Walker.

*Type locality*.—Los Angeles County, Calif.

*Type*.—U.S.N.M. no. 51795.

*Paratypes*.—Cornell University; Oregon State Agricultural College.

*Remarks*.—Three females and three males (one of the latter without abdomen) including holotype and allotype, reared under Bureau of Entomology no. 174°; one male reared at Saticoy, Calif., by S. E. Flanders, ostensibly, but very doubtfully, from *Carpocapsa pomonella* (Linnaeus); one male taken July 5, 1930, at Phoenix, Oreg., by H. A. Scullen; one female from San Juan Capistrano, Calif., July 9, 1930, J. C. Elmore; two females from Felton, Santa Cruz Mountains, Calif., May 15–19, 1907, J. C. Bradley; and one female from Priest Valley, Monterey County, Calif., 2,500 feet, August 1927, J. C. Bradley.

### 3. EXETASTES CARINATUS, new species

*Female*.—Length 10 mm, antennae 8.5 mm.

Very similar to *septum* but with temples more strongly receding; cheeks straight; hypostomal carina lower; postocellar line distinctly longer than ocellocular line and fully twice the diameter of lateral ocellus; antenna with 46 joints; hind femur extending distinctly beyond apex of abdomen; ovipositor sheath distinctly a little shorter than first tergite.

Wings hyaline, the front wing with two distinct fuscous fasciae.

*Type locality*.—Dimmit County, Tex.

*Type*.—U.S.N.M. no. 51796.

One female taken March 30, 1933, by S. E. Jones.

### 4. EXETASTES LASIUS, new species

PLATE 17, FIGURES 16, 30; PLATE 18, FIGURE 56; PLATE 19, FIGURE 75; PLATE 20, FIGURE 79; PLATE 21, FIGURE 118

Very distinct in form and color and in the sculpture and pilosity of head and thorax, as well as in several structural details.

*Female*.—Length 10 mm, antenna 7 mm.

Head and thorax mat, very finely and densely punctate and with dense silvery pubescence, longest on lower part of head and very short on dorsum of thorax, this sculpture and vestiture also embracing coxae.

Head very thin medially; temples strongly receding, nearly flat, little more than half as long as short diameter of eye; occiput rather deeply concave; frons moderately concave; face more than twice as broad as long, flat with a small median elevation; clypeus more than twice as broad as long, distinctly divided by differences in slope, sculpture, and color of the basal and apical portions, broadly submarginate apically; cheeks in front view nearly straight; malar space about as long as basal width of mandible; mouth as broad as face;

mandible narrow, nearly twice as long as broad at base; occipital and hypostomal carinae meeting close to base of mandible; eyes distinctly divergent below, shorter than width of face; postocellar line longer than ocellocular line and nearly twice diameter of a lateral ocellus; antenna slender, filiform, very slightly tapering, 45- to 47-jointed, first joint of flagellum twice as long as second.

Thorax short and stout; notauli absent; scutellum elongate triangular, strongly convex longitudinally, discally more sparsely and its lateral areas more coarsely punctate than mesoscutum; propodeum strongly convex both transversely and longitudinally, entirely without carinae though with a shallow longitudinal impression medially.

Legs, especially tibiae and tarsi, slender; hind femur little more than two-thirds as long as tibia and hardly reaching apex of abdomen; inner hind calcarium not nearly reaching middle of basitarsus; apical joints of tarsi very slender, claws slender, weakly curved, fourth joint of hind tarsus nearly as long as fifth.

Wings: Apical abscissa of radius strongly curved at base, only about a half longer than first abscissa; areolet large, sessile, second intercubitus nearly straight, recurrent in middle; second discoidal cell broad, the discocubitus strongly curved with trace of ramellus, basal abscissa of subdiscoideus distinctly though slightly longer than the strongly flexed recurrent; nervulus strongly postfurcal; abscissula nearly twice as long as intercubitella.

Abdomen broad, fusiform, very weakly compressed at extreme apex; first tergite triangular, as broad as long, finely and densely punctate; second tergite much broader at base than long, weakly punctate at base, gastrocœli distinct, transverse; abdomen otherwise polished; ovipositor slender, slightly recurved, sheath distinctly longer than first tergite.

Black, with yellow as follows: Apical portion of clypeus; sometimes a small spot in middle of face; inner orbit from bottom to top, where it curves mesad and ends in a point behind the lateral ocellus; outer orbit triangularly broadened below, where it is nearly confluent with a small spot on cheek at base of mandible; two narrow stripes on mesoscutum, broadening anteriorly and slightly so posteriorly; scutellum largely; postscutellum; more or less distinct spots on subalar tubercles and on each side of propodeum toward apex; spots on anterior face of front coxa and dorsal face of hind coxa; broad apical margins of tergites and venter except sternites; tegulae, humeral angles of pronotum, and radices of wings stramineous; legs beyond coxae largely ferruginous, trochanters black except narrow apical margin of basal joint and dorsal and ventral surfaces of apical joint; all femora blackish within, the front and middle femora yellow-striped anteriorly. Wings hyaline, venation blackish, stigma paler, with base more or less yellowish.

*Male*.—Very similar to female in structure and color; spots on lower anterior margin of pronotum and on middle coxa and apex of genital sheath yellow.

*Host*.—*Euxoa auxiliaris* Grote.

*Type locality*.—Derby, Kans.

*Type*.—U.S.N.M. no. 51797.

*Remarks*.—One female and two males, including type and allotype, reared March 16–20, 1934; one female from Herington, Kans., reared by H. H. Walkden under Acc. no. 2193.4; one female, Bucklin, Kans., reared March 22, 1935, by H. H. Walkden, under Acc. no. 35189; one female from Wellington, Kans., E. G. Kelly; and two females, Lincoln, Nebr., October 25, 1923, Owen Bryant.

Two other species of the *lasius* group, each represented by a single much mutilated specimen, are before me, one from Oregon, minus the abdomen, and one taken from the stomach of a roadrunner at Tucson, Ariz. (Biological Survey no. 188825).

#### 5. *EXETASTES PICTUS*, new species

The group represented by this and the next following species comprises the smallest species of *Exetastes*. They are characterized by the small evenly convex clypeus, distinctly defined very short petiolar area, short depressed abdomen, very short ovipositor, nearly straight second recurrent vein, yellow ornamentation of the head and thorax, and red abdomen.

*Female*.—Length 6.5 mm.

Head thin, temples very strongly receding, nearly flat, little longer than half of short diameter of eye, polished, weakly punctate; occiput shallowly concave; frons flat, densely finely punctate, mat; face weakly elevated medially, densely and more coarsely punctate, mat; clypeus evenly weakly convex, little more than half as broad as face and two-thirds as long as broad, narrowly truncate at apex, finely coriaceous, mat with scattered punctures; cheeks straight in front view, their extended angle sharply acute, posteriorly more densely punctate than temples; malar space a little more than half basal width of mandible, mouth barely as broad as face; mandibles more than two-thirds as broad as long, strongly narrowing apically; junction of occipital and hypostomal carinae removed from base of mandible by about half the width of latter; eyes large and bulging, slightly longer than width of face, faintly convergent below; postocellar line longer than ocellocular line and nearly twice diameter of a lateral ocellus; antennae (broken) slender filiform, first joint of flagellum hardly twice as long as second, the latter a little more than twice as long as thick.

Thorax robust, short and deep, shining, with moderately coarse and dense punctation, somewhat coarser and tending to rugulosity on propodeum; notauli absent; scutellum evenly convex, sparsely punc-

tate; propodeum weakly convex to the very short, distinct, precipitous petiolar area, pleural carina absent before spiracle; spiracles small, broadly oval.

Legs long, moderately slender; hind femur reaching distinctly beyond apex of abdomen; longer hind calcarium nearly two-thirds as long as basitarsus.

Wings: Apical abscissa of radius weakly curved, hardly twice as long as basal abscissa; areolet large, with second intercubitus nearly straight and unusually long so that the areolet is narrower than usual with its outer angle sharply acute, recurrent at middle; second discoidal cell rather narrow, basal abscissa of subdiscoideus more than a half longer than second recurrent, the latter nearly straight; nervulus interstitial; abscissula more than a half longer than intercubitella.

Abdomen polished, little longer than head and thorax, strongly depressed except at extreme apex, where it is weakly compressed; first tergite more than half as broad at apex as long, its sides weakly concavely curved; second tergite hardly longer than broad at base; ovipositor only briefly exerted, sheath barely half as long as first tergite.

Head and thorax black with yellow markings as follows: Clypeus except its brownish apex; mandibles; annulus embracing flagellar joints 9-14; broad anterior margin and humeral angle of pronotum; two large spots on anterior margin of mesoscutum; scutellum and postscutellum; tegulae; subalar tubercle; upper posterior angle and a large spot on lower posterior angle of mesopleurum; and a large spot at apex of metapleurum confluent with a narrower band across apex of propodeum; legs ferruginous, front and middle coxae entirely and trochanters partly yellow, all tibiae at base yellowish, hind tibia narrowly blackish at apex, hind tarsus blackish with a yellow annulus embracing second joint and apical half of basal joint; wings hyaline, venation brown, stigma paler; abdomen ferruginous, first tergite more yellowish, sheath concolorous.

*Type locality*.—Devils River, Tex.

*Type*.—U.S.N.M. no. 51798.

One female taken May 4, 1907, by F. C. Pratt.

#### 6. EXETASTES BIOGULATUS Cresson

PLATE 17, FIGURES 19, 24; PLATE 18, FIGURE 58; PLATE 19, FIGURE 77; PLATE 20, FIGURE 80; PLATE 21, FIGURE 119

*Exetastes bioculatus* CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 169, 1872; male.  
*Rhynchophala brevicorpa* DAVIS, Trans. Amer. Ent. Soc., vol. 24, p. 274, 1897; female. New synonymy.

*Female*.—Differs from the above description of *pictus* Cushman principally as follows:

Slightly larger.



Head thicker with temples longer and less sharply receding (about  $45^\circ$  to longitudinal axis of body); extended angle of cheeks hardly acute; postocellar line about equal to ocellocular line; antenna 43-jointed; propodeum more distinctly rugose and with a median longitudinal groove basally, pleural carina distinct throughout with the spiracle far above it; outer angle of areolet nearly right, recurrent beyond middle; nervulus slightly postfurcal; abscissula hardly a half longer than intercubitella.

Antennal annulus beginning on flagellar joint 11; scape more or less distinctly reddish or yellowish below; propodeum and metapleurum largely or entirely ferruginous, not at all yellow; mesopleurum entirely black below; all coxae and trochanters ferruginous, only front coxa yellowish in front; hind tarsus yellow with more or less of basitarsus and the apical one or two joints brownish.

*Male*.—Temples much more strongly convex; abdomen depressed throughout.

Propodeum usually more extensively black; front coxa and trochanter and hind tarsus more extensively yellow. Otherwise like female.

*Type locality*.—Of *bioculatus*, Texas; of *brevicorpa*, Algonquin, Ill.

*Type*.—Of *bioculatus*, U.S.N.M. no. 4018; of *brevicorpa*, Acad. Nat. Sci. Philadelphia no. 4329.

*Remarks*.—In addition to the types of both names the material examined includes five specimens of each sex as follows: Brownsville, Tex., May 1921, J. C. Bridwell; Victoria, Tex., April 19, 1913, J. D. Mitchell; Onaga, Kans., Crevecoeur; (homotype of *brevicorpa*) Lawrence, Kans., Hugo Kahl; Lexington, Ky.; Dixie Landing, Va., May 27, C. L. Marlatt; Rosslyn, Va., June 15, T. Pergande; and Georgetown, D. C., H. H. Smith.

#### 7. EXETASTES RIDENS, new species

PLATE 18, FIGURE 55; PLATE 19, FIGURE 74; PLATE 20, FIGURE 91; PLATE 21, FIGURE 117

This species and *illinoiensis* (Walsh) form a distinct group characterized by the very broad short face and clypeus, small eyes, long, narrow, and strongly curved mandibles, short calcaria, nearly straight second recurrent vein, and very long strongly upcurved ovipositor.

*Female*.—Length 12 mm, antennae 9 mm.

Head thin medially, occiput deeply concave, temples long convex, moderately receding; subpolished, minutely sparsely punctate; frons nearly flat, densely finely punctate; face nearly three times as broad as long, nearly flat with a small prominent median elevation, finely densely punctate; clypeus nearly three times as broad as long, distinctly transversely divided near base, broadly rounded and medially straight or weakly emarginate at apex; basal portion more closely and

coarsely punctate than the faintly coriaceous apical portion; cheeks in front view straight, their extended angle very acute; malar space two-thirds as long as basal width of mandible, mat; mouth very broad, broader than face; mandible more than twice as long as broad at base, strongly curved; junction of occipital and hypostomal carinae shortly behind base of mandible; eyes small, broadly oval, prominent, parallel, shorter than width of face; postocellar and ocellocular lines equal and distinctly more than twice as long as diameter of a lateral ocellus; antenna slender filiform, about 50-jointed, only slightly tapering, first joint of flagellum barely twice as long as second, second joint more than twice as long as thick.

Thorax nearly twice as long as deep, very finely and rather densely punctate; notauli very broadly and weakly indicated; scutellum evenly convex, polished, sparsely punctate; propodeum evenly convex both transversely and longitudinally, finely irregularly reticulate rugulose, more coarsely and transversely so laterally toward apex, without carinae, pleural carina at most obsoletely indicated, spiracles rather small, elongate oval, far above pleural carina.

Legs not especially long; front and middle legs slender; hind femur rather stout, little more than two-thirds as long as tibia and hardly reaching to apex of abdomen; inner hind calcarium less than half as long as basitarsus; apical joint of hind tarsus nearly as long as third joint.

Wings: Apical abscissa of radius strongly curved at base, much less than twice as long as basal abscissa; areolet large, regular, subsessile, recurrent at middle; second discoidal cell rather long, second recurrent hardly two-thirds as long as basal abscissa of subdiscoideus, nearly straight; nervulus distinctly postfurcal; abscissula a half longer than intercubitella.

Abdomen slender, especially in profile; polished and impunctate, except first tergite laterally toward base; first tergite more than half as broad at apex as long, tergites 2-4 as long as broad at base; ovipositor long, stout, strongly recurved, sheath more than half as long as abdomen.

Head and thorax black; apex of clypeus brownish or yellowish; small spot at top of eye yellow; abdomen ferruginous with first two tergites more or less and ventral plica and hypopygium blackish; legs black, front femur and tibia anteriorly, middle femur apically, yellowish, hind femur more or less ferruginous on outer surface and rarely largely ferruginous, in the latter case the tibia largely ferruginous; hind tarsus with joints 2-4 sometimes dark reddish; wings uniformly dark infumate.

*Male*.—Essentially like female but malar space shorter, ocelli larger, temples more strongly convex; apical portion of clypeus pale yellow; pattern of front and middle legs much as in female but black largely

replaced by ferruginous; hind femur and tibia very largely ferruginous; wings dilutely infumate; abdomen almost entirely red, plica yellowish.

*Type locality*.—Vernon, British Columbia.

*Type*.—U.S.N.M. no. 51799.

*Paratypes*.—Canadian National Collection; Oregon State Agricultural College; Cornell University.

*Remarks*.—Described from 24 females and 7 males as follows: The holotype, allotype, and 13 paratypes from Vernon, British Columbia, the holotype taken by D. G. Gillispie, May 16, 1927; the allotype by E. P. Venable, April 12, 1926; the paratypes by E. P. Venable, May 10, 1903; I. J. Ward, May 20, 1927; M. J. Ruhman, May 18, 1917; E. A. Rendell, May 20, 1925; from Oliver, British Columbia, four collected by C. B. Garrett, May 1 and 5, 1923, and E. R. Buckell, April 23, 1927; two by P. N. Vroom, May 16, 1922; from Hedley, British Columbia, one by W. B. Anderson, May 5, 1920; from Okanogan Falls, Wash., two by E. M. Anderson, April 27 and 29, 1913; from Pullman, Wash., one by C. V. Piper; one specimen labeled simply "Eastern Wash."; three from Lewiston, Idaho, J. M. Aldrich, April 27, 1912; one from Logan, Utah; and one unlabeled.

8. *EXETASTES ILLINOIENSIS* (Walsh)

PLATE 17, FIGURES 18, 26

*Leptobatus illinoiensis* WALSH, Trans. Acad. Sci. St. Louis, vol. 3, p. 148, 1873; female.

*Exetastes illinoiensis* (Walsh) CRESSON, Synopsis of families and genera of Hymenoptera of America north of Mexico, p. 206, 1887.

*Female*.—Distinct in the conspicuous yellow markings of the thorax, this species is very similar to *ridens* Cushman structurally, differing essentially only as follows: Temples less strongly convex and more sloping; eyes less convex; postocellar line distinctly longer than ocellular line; thorax stouter; notauli not at all indicated; mesoscutum more shining and less densely punctate; propodeum more coarsely rugose, especially along a more or less well defined median band.

Differs from *ridens* in color as follows: Flagellum reddish, especially below from near base to about the apical third; mandible partly yellow; two broad yellow bands on mesoscutum, confluent behind and curving backward along the sides to tegulae; humeral angles and sometimes a small spot near anterior margin of pronotum, subalar tubercle, tegulae and scutellum, and sometimes postscutellum also, yellow; front and middle legs each with a virtually continuous stripe extending from apex of coxa to apex of tibia, their tarsi reddish, paler above, otherwise black; hind leg with a similar stripe beginning at apical joint of trochanter; wings nearly hyaline with costa and base of stigma yellow.

*Male*.—Differs from female structurally as does that of *ridens*; also flagellum entirely black; a small yellow spot on each side of face; yellow of mesoscutum confined to subtriangular spots on anterior lateral margins; scutellum, postscutellum, and anterior margin of pronotum immaculate; yellow markings of legs broader.

*Type locality*.—Illinois.

*Type*.—Destroyed.

*Remarks*.—Material examined includes one female and three males reared from "cutworms" at Battle Creek, Mich., April 25, 1916, by A. F. Satterthwait under his "Cage No. C610b"; two females from Denver, Colo., April, E. S. Tucker; one of each sex from Colorado, C. F. Baker; and one female without data except the date April 28, 1898.

9. EXETASTES FLAVUS, new species

PLATE 16, FIGURE 4; PLATE 17, FIGURE 28; PLATE 18, FIGURE 59; PLATE 20, FIGURE 89

This and the next following species constitute a group conspicuous principally because of the pale yellow color of the body with contrastingly colored maculation and the unusually large ocelli. Other features characteristic of the group are the long weakly convergent cheeks, long nearly flat clypeus, short hind femur, and long curved ovipositor.

*Female*.—Length 12 mm, antennae 9.5 mm.

Head moderately thick, occiput shallow, temples sharply receding, convex, polished, very sparsely and minutely punctate; frons weakly concave, medially sparsely punctate; face more densely punctate, more than half as long as broad, somewhat roundly elevated medially; clypeus nearly two-thirds as long as broad, much narrower than face, weakly transversely divided near base, sharply rounded at apex, narrowly subtruncate, apical portion polished, with small scattered punctures; cheeks in front view straight, their extended angle very acute; malar space three-fourths basal width of mandible; mouth exactly as broad as face; mandible nearly twice as long as broad, gradually narrowing toward apex; junction of occipital and hypostomal carinae distant from mandible by nearly two-thirds the basal width of mandible; eyes prominent, as long as width of face, parallel; diameter of a lateral ocellus as long as postocellar line and much longer than ocellocular line; antenna about 50-jointed, slender, tapering but not attenuate, first joint of flagellum barely twice as long as second, which is nearly twice as long as thick, all other joints distinctly longer than thick.

Thorax rather elongate, polished, with fine moderately dense punctuation; notauli absent; scutellum strongly convex, sparsely punctate; propodeum rather weakly convex, medially mat and indefi-

nately rugulose, otherwise punctate, with faint trace of apical carina, pleural carinae absent, spiracles small, elongate.

Legs rather slender, hind femur fully six times as long as thick, barely two-thirds as long as tibia; inner hind calcarium not or barely reaching middle of basitarsus.

Wings: Apical abscissa of radius moderately curved at base, much less than twice as long as basal abscissa; areolet large, regular, sessile, recurrent in middle; second discoidal cell elongate, basal abscissa of subdiscoideus fully a half longer than recurrent, the latter somewhat curved above; nervulus distinctly postfurcal; abscissula nearly twice as long as intercubitella.

Abdomen polished, distinctly longer than head and thorax together, slender in both dorsal and profile views; first tergite not or barely half as broad as long, second tergite longer than broad at base; ovipositor strongly recurved, sheath nearly as long as first two tergites together.

Pale lemon yellow with black markings as follows: Occiput, narrow circles around ocelli; spots in frontal scrobes (confluent medially), clypeal foveae, extreme base and teeth of mandibles, the normally concealed posterior part of propleurum, a narrow transverse streak on pronotum, three longitudinal stripes on mesoscutum, scutellar fovea, lateral areas of scutellum and postscutellum, a small spot below front wing, another on speculum, and another in position of sternaulus, prepectus in part, sometimes a disconnected streak on each side of mesosternum, metasternum, mesolcus posteriorly, more or less of the thoracic sutures, first tergite at base and medially, paired clavate spots sometimes confluent apically on tergites 2 and 3, broad basal bands on tergites 4-6, and sometimes sternites partly. Antennal scape largely yellow, flagellum black, reddish below for most of its length. Legs yellow with all coxae and trochanters more or less black basally, front and middle femora more or less black behind, hind femur ferruginous below and on inner side, hind tibia pale ferruginous below and apically, tarsi reddish apically. Wings hyaline with stigma and costa yellow, veins brown. Ovipositor sheath black.

*Type locality*.—Bernadillo County, N. Mex.

*Type*.—U.S.N.M. no. 51800.

*Paratypes*.—Colorado Agricultural College.

*Remarks*.—Six females, two from the type locality, 1896, B. Brown, and four from Roggen, Colo., May 19, 1934, M. T. James. The Colorado specimens have the hind femur somewhat thicker than in the type, but there is considerable variation in this respect.

#### 10. *EXITASTES PALLIDUS*, new species

*Female*.—Of same size and for the most part of the same structure as *flavus*, but differing as follows: Occiput somewhat more deeply concave; extended angle of cheeks even more acute; malar space

nearly as long as basal width of mandible; diameter of an ocellus not or barely as long as ocellocular line; antenna slightly shorter, with 45 joints or less, subapical joints as thick as long; pleural carinae more or less distinct throughout; hind femur not or barely five times as long as thick.

Head, thorax, and legs colored as in *flavus* except that the black markings are usually less extensive, some even missing; tergites 1-3 immaculate yellow except for traces of the black on first; tergites 4-6 pale ferruginous at base.

*Type locality*.—Buffalo, S. Dak.

*Type*.—U.S.N.M. no. 51801.

*Paratype*.—Colorado Agricultural College.

*Remarks*.—Three females, two from the type locality July 31, 1924, and one from Alamosa, Colo., August 11, 1934. The Colorado specimen very closely approximates *flavus* in the extent of black on head, thorax, and legs.

#### 11. EXETASTES PROPINQUUS, new species

PLATE 16, FIGURE 8; PLATE 17, FIGURE 27; PLATE 18, FIGURES 48, 57; PLATE 20, FIGURES 92, 98; PLATE 21, FIGURE 107

*Exetastes scutellaris* HOWARD (not Cresson), Insect book, pl. 9, fig. 17, 1903; female.  
*Exetastes propinquus* CRESSON (MS. name), Viereck in Smith, Insects of New Jersey, p. 618, 1910.

The specimen illustrated as *scutellaris* in Howard's "Insect Book" and the specimens on which Viereck based his New Jersey records form a part of the type series, also a specimen labeled "*propinquus* Cress. MS." in Viereck's hand.

This is the first of a distinct group of six species characterized by the unusually thick head with very shallowly convex eyes and strongly convex temples, stout legs with the claws in female strongly pectinate, and very broad abdomen.

The first two species of this group differ from the others by the more distinctly divided clypeus, the apical portion being abruptly impressed and the basal portion ridgelike, by the evenly infumate wings in both sexes, and by the shorter, straight ovipositor.

*Female*.—Length 11 mm, antennae 10 mm.

Head barely twice as broad as thick, densely finely punctate and mat anteriorly, more sparsely punctate and shining posteriorly; occiput shallowly concave; temple very strongly convex but not reaching outside tangent of eyes; frons weakly concave medially; face convex with a more or less well defined median elevation and somewhat impressed above on each side; clypeus somewhat narrower than face, a little more than half as long as broad with basal portion elevated and apical portion impressed, strongly rounded at apex and with a more or less distinct median longitudinal groove, sometimes weakly

emarginate; cheeks straight, their extended angle moderately acute; malar space slightly less than half as long as basal width of mandible; mouth distinctly broader than face; mandible nearly twice as long as broad at base; junction of occipital and hypostomal carinae less than half width of mandible from base of latter; eyes very shallowly convex, as long as width of face, parallel; postocellar line slightly longer than ocellocular line and nearly twice as long as diameter of a lateral ocellus; antenna rather stout, tapering but not attenuate toward apex, 46- to 50-jointed, basal joint of flagellum about four times as long as thick at apex, second barely twice as long as thick, middle joints as thick as long.

Thorax shining, with fine and moderately dense punctation; notauli absent; scutellum strongly convex, sparsely punctate; propodeum strongly convex both transversely and longitudinally, finely and densely reticulate punctate except at base, where it is more sparsely punctate, spiracles rather small, elongate, situated shortly above the obsoletely indicated pleural carinae.

Legs stout, hind femur hardly six times as long as deep, barely two-thirds as long as tibia; inner hind calcarium more than half basitarsus; tarsus stout, apical joint nearly as long as third; claws, especially front and middle ones, strongly pectinate.

Wings: Apical abscissa of radius moderately curved at base, much less than twice as long as basal abscissa; areolet somewhat irregular, its apical angle rather sharply acute; second discoidal cell rather broad, basal abscissa of subdiscoideus hardly a half longer than second recurrent, the latter strongly curved above; nervulus distinctly postfurcal; abscissula twice as long as intercubitella.

Abdomen stout, weakly compressed at apex; first tergite strongly depressed throughout, much more than half as broad as long, second not or barely as long as broad at base; ovipositor straight, sheath distinctly shorter than first tergite.

Ferruginous with face, clypeus, mandibles, malar space, indefinite markings on anterior margin of mesoscutum, scutellum, and tegulae more or less distinctly yellowish; occiput, stemmaticum, thoracic sutures, areas around scutellum and postscutellum, and meso- and metasterna more or less stained with blackish; flagellum black above, reddish below; legs concolorous, the coxae more or less black at extreme base; hind tarsus with joints 2-4 yellow; wings deeply infumate, stigma ferruginous; ovipositor sheath black.

*Male*.—Essentially like female, but malar space slightly shorter, ocelli a little larger, claws not pectinate, yellow markings more distinct and extensive, and the black usually less extensive.

*Type locality*.—Washington, D. C.

*Type*.—U.S.N.M. no. 51802.

*Paratypes*.—Collection of Henry K. Townes.

*Remarks.*—Described from 23 females and 11 males as follows: District of Columbia—three females, the holotype taken by C. N. Ainslie and two on September 8, 1882, and September 23, 1888, collector unknown. Virginia—two females, September 25, 1883, and October 8, 1888, T. Pergande; one female and one male, Falls Church, September 12, 1912, C. T. Greene; one male (the allotype), Vienna, September 27, 1911, R. A. Cushman. Maryland—one female, Bethesda, September 14, 1913, J. C. Crawford; one male, near Plummers Island, September 5, 1914, J. C. Crawford. Pennsylvania—one female, Ogontz, September 7, 1902; one male, Delaware County, August 31, 1897. New Jersey—one female, Riverton, September 11, 1904, G. M. Greene; one female, Boonton, September 11, 1901, G. M. Greene; one female and one male, Great Notch, September 8, 1901, G. M. Greene; one male, Westville, August 26, 1895; two females from the Asa Fitch collection, probably from New York. North Carolina—one female, Raleigh, September 26, 1917, R. W. Leiby. South Carolina—one female, Chapel Hill, Sept. 28, 1883, B. F. Tyson; three females and two males, Greenville, September 18–20, 1934, H. K. Townes; two males, Chesney, September 19, 1934, H. K. Townes. Florida—one female. Tennessee—two females, Nashville (Nashville no. 1522), September 14, G. G. Ainslie. Texas—one male. Del Rio, October 21, 1912, J. D. Mitchell. Also two females without data, one of which is the specimen figured in Howard's "Insect Book."

## 12. EXETASTES SCUTELLARIS Cresson

*Exetastes scutellaris* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 279, 1865: female, male.

*Female and male.*—Very similar in size, form, and structure to *propinquus*, from the above description of which it differs only as follows: Wings less deeply infumate and more yellowish with stigma more yellowish; apex of hind tibia and basitarsus blackish; antenna (complete in only two specimens) with only 42 joints; pleural carinae more distinct; ovipositor sheath subequal in length to first tergite.

*Type locality.*—Colorado.

*Type.*—Acad. Nat. Sci. Philadelphia no. 1620.

*Remarks.*—Specimens examined include the holotype female and a paratype male in the National Museum (paratype no. 44734); a female (compared with the holotype), Boulder, Colo., June 20, 1897; one female, Colorado Springs, Colo., 5,915 feet, August, E. S. Tucker; one male, Spring Canyon, near Fort Collins, Colo., June 18, 1929, Klotz; one male (Cornell University Collection), Fort Collins, Colo., August 4, 1902, L. A. Titus; one female (Webster no. 5521), Springer, N. Mex., September 20, 1909, C. N. Ainslie; one female, Mendon, Utah, July 16, 1907; and one male and one female (Canadian National Collection), Lethbridge, Alberta, July 10, 1922, and August 8, 1921,



H. L. Seamans. Included are specimens in the Canadian National Collection, Cornell University, and the collection of Andrew R. Park, Jr. I am convinced that the specimens recorded as *scutellaris* in Smith's "Insects of New Jersey" (1910) are erroneously identified, but I have not been privileged to examine them.

13. *EXETASTES IGNEIPENNIS*, new species

PLATE 16, FIGURE 6; PLATE 17, FIGURE 33; PLATE 18, FIGURE 60; PLATE 19, FIGURE 72; PLATE 20, FIGURES 86, 101

Very distinct among the species with thick head because of the black, yellow-ornamented head and thorax and bright yellowish wings with smoky apices.

*Female*.—Length 12 mm, antennae broken.

Head barely twice as broad as thick, finely punctate, very densely so and mat anteriorly, sparsely so and shining posteriorly; occiput rather shallowly concave; temples very strongly convex, nearly as long as short diameter of eye; frons slightly concave above antennae, with small polished scrobes; face convex, with a deep impression on each side above; sculpture coarser medially; clypeus nearly as broad as face and about twice as broad as long; the weakly elevated and strongly punctate basal portion much shorter than the flat, finely shagreened and mat apical portion, apex strongly rounded and with a shallow median emargination; cheeks in front view short and straight, their extended angle acute; malar space somewhat less than half basal width of mandible; mouth much broader than face; mandible stout, evenly curved, about three-fourths longer than broad at base; junction of occipital and hypostomal carinae removed from base of mandible by more than half basal width of the latter; eyes rather small, moderately convex, hardly as long as width of face, parallel; postocellar line slightly longer than ocellocular line and nearly twice diameter of a lateral ocellus, ocelli touching posterior tangent of eyes; antenna (apices of both gone) short and rather stout, slightly thicker in middle, basal joint of flagellum twice as long as second, joints from tenth on as thick as or thicker than long.

Thorax shining, finely and densely punctate; prescutum with a narrow median longitudinal ridge; notauli broadly impressed discally; scutellum strongly evenly convex, less densely punctate than scutum; propodeum evenly convex with slight median trace of apical carina and distinct pleural carinae, finely reticulate rugose; spiracles elongate, situated shortly above pleural carinae.

Legs stout, hind femur a little more than two-thirds as long as tibia; inner hind calcarium almost exactly half as long as basitarsus; tarsus stout, as long as tibia, third and fifth joints equal; claws strongly pectinate.

Wings: Apical abscissa of radius moderately curved at base, barely a half longer than basal abscissa; areolet slightly irregular, shortly petiolate; second discoidal cell rather narrow, basal abscissa of subdiscoides about a half longer than second recurrent; second recurrent flexed above; nervulus shortly postfurcal; abscissula twice as long as intercubitella.

Abdomen broad, weakly compressed at apex; first tergite depressed throughout, not nearly twice as long as broad, second barely as long as broad at base; ovipositor faintly recurved, sheath nearly as long as first two tergites.

Head and thorax black, face, scape below, large triangular mark on each side of mesoscutum anteriorly, scutellum, and postcutellum yellow; clypeus light brownish at base, stramineous at apex; mandibles partly brownish or yellowish; flagellum blackish; coxae and bases of trochanters dark brown, front and middle legs otherwise yellow, hind leg yellow with femur and tibia apically broadly brown, basitarsus dark reddish; wings yellow hyaline with apices broadly dilutely infumate, tegulae stramineous, more or less brownish discally; abdomen yellow, more or less stained with reddish, segments beyond fourth largely blackish; sheath black.

*Male*.—Essentially like female, but antennae longer and more slender, 44-jointed; claws not pectinate; clypeus, mandibles, malar space, and anterior margin of pronotum medially also, yellow; markings of mesoscutum usually extending backward more or less along notauli; front and middle trochanters entirely and their coxae mostly yellow; fifth tergite yellow; genital sheath pale at apex.

*Type locality*.—White Mountains, N. Mex., south fork of Eagle Creek, about 8,000 feet.

*Type*.—U.S.N.M. no. 51803.

*Paratypes*.—American Museum of Natural History; Cornell University.

*Remarks*.—Described from two females and four males, the holotype captured August 19 by C. H. T. Townsend; the paratype female without data; the allotype taken at Santa Fe, N. Mex., in August by T. D. A. Cockerell; one male from Cornell University taken at Atzacapulcalco, Mexico, July 5–31, 1931; two other males at Santa Fe, N. Mex., in July, also by Cockerell; and one male in the collection of the American Museum of Natural History taken at 3,700 feet near Wray, Colo., August 17–19, 1919, and bearing the number F 4411A.

#### 14. EXETASTES BUCCATUS, new species

*Female*.—Length 10 mm, antennae 8 mm.

Related in the thick head and stout abdomen to the three immediately preceding species, this species differs from the above description of *propinquus* principally as follows:

Head, especially the face, less densely punctate and more shining; temple reaching outside tangent of eye; clypeus less sharply divided into basal and apical portions, without a median longitudinal groove apically; malar space half as long as basal width of mandible; junction of occipital and hypostomal carinae half basal width of mandible from latter; eyes distinctly shorter than width of face, faintly divergent below, antenna shorter, hardly tapering, less than 40-jointed; pleural carinae more distinct; legs even stouter, the hind femur distinctly less than six times as long as deep; second discoidal cell slightly narrower; nervulus at most slightly postfurcal; ovipositor recurved, sheath as long as first two tergites.

Flagellum, pedicel, and upper side of scape black; wings dilutely infumate.

*Male*.—Very similar structurally to female, but head and sides and sternum of thorax largely black, the yellow markings more distinct; anterior margin of pronotum, propleura largely, an oblique streak on mesopleurum, and front and middle coxae and trochanters largely, yellow.

*Type locality*.—San Juan Valley, 25 miles northeast of Paso Robles, Calif.

*Type and paratype*.—California Academy of Sciences.

*Allotype and paratype*.—U.S.N.M. no. 51804.

*Remarks*.—The holotype, allotype, and one female paratype were all taken at the type locality on April 22, 1932, by E. P. Van Duzee, while a second female paratype was taken on the same date by the same collector 4 miles west of Paso Robles. Another female is from Spring Canyon, near Fort Collins, Colo., June 23, 1929, Klotz, collector. A second male, which because of its poor condition is excluded from the type series, is labeled simply "Utah."

15. *EXETASTES PECTINATUS*, new species

PLATE 18, FIGURE 47; PLATE 21, FIGURE 115

*Female*.—Length 10 mm, antennae 7 mm.

Belongs to the same species group as *propinquus*, from the above description of which it differs principally as follows: Clypeus much more than half as long as broad, very weakly divided, basal portion weakly convex, apical portion weakly impressed; extended angle of cheeks sharply acute; malar space fully three-fourths as long as basal width of mandible; mandible fully twice as long as broad at base, weakly narrowed toward apex; junction of occipital and hypostomal carinae much more than half basal width of mandible from the latter; eyes faintly convergent; antennae only very slightly tapering, less than 40-jointed; propodeum with punctures distinct, not reticulate; pleural carina more distinct posteriorly and replaced anteriorly by a distinct groove; hind femur three-fourths as long as tibia; second discoidal cell

narrower, basal abscissa of subdiscoideus nearly twice as long as second recurrent, the latter only moderately curved above; ovipositor recurved, sheath nearly as long as first two tergites.

Black of head and thorax more extensive; flagellum entirely black; hind coxa more extensively black below and within; hind tarsus entirely ferruginous; wings only faintly infumate.

*Type locality*.—Sugar Loaf, Colo.

*Type*.—U.S.N.M. no. 51805.

*Paratypes*.—California Academy of Sciences; Canadian National Collection.

*Remarks*.—Ten females, the holotype taken July 1 by T. D. A. Cockerell; three collected in Colorado by C. F. Baker; one, Harney Peak, S. Dak., July 22, 1924; one, Custer, S. Dak., July 19, 1924; one, Waterton, Alberta, July 1, 1924, H. L. Leamans; one, Waterton Lakes, Alberta, July 4–11, 1923, J. McDunnough; two, Glacier National Park, Mont., June 30, 1930, E. C. Van Dyke.

What is probably the male of this species, though I do not include it in the type series, is represented by a single male in poor condition captured by E. P. Van Duzee on July 23, 1915, at Half Moon Lake, Tahoe, Calif. It differs from the female in the shorter malar space, larger ocelli, more slender antennae with all joints at least slightly longer than thick, the propodeum medially and posteriorly rugulose with a distinct apical carina, the red of head and thorax largely replaced by black, with only supraorbital spots, mesoscutum largely and propodeum partly ferruginous, the yellow brighter.

#### 16. *EXETASTES BREVICORNIS*, new species

*Female*.—Very closely related to *pectinatus*, from which it differs principally in having the extended angle of the cheeks somewhat less acute; hind femur barely two-thirds as long as tibia; head, thorax, and coxae less extensively black; flagellum largely ferruginous and hind femur and tibia blackish apically, the tibia distinctly yellow at base.

*Male*.—Differs from female in the shorter malar space, larger ocelli, distinct apical carina of propodeum with two more or less distinct carinae diverging forward from it; more extensively black head and thorax, the latter being sometimes very largely or entirely black laterally, ventrally, and on propodeum; brighter yellow markings; more extensively black hind legs, with the middle tarsal joints yellowish.

*Type locality*.—Calgary, Alberta.

*Type*.—U.S.N.M. no. 51806.

*Paratypes*.—Canadian National Collection.

*Remarks*.—Four females and six males collected at the type locality, July 16–19, 1924, by George Salt; and one female taken July 10, 1932, at Lethbridge, Alberta, by H. L. Seamans.

17. *EXETASTES BIFENESTRATUS*, new name

PLATE 16, FIGURE 11; PLATE 17, FIGURE 32; PLATE 18, FIGURE 61; PLATE 19, FIGURE 76; PLATE 20, FIGURES 84, 94

*Ichneumon bifasciatus* SAY, Contr. MacLurian Lyc. Arts and Sci., vol. 1, p. 73, 1828; in LeConte, The complete writings of Thomas Say on the entomology of North America, vol. 1, p. 377, 1859; female (preoccupied by *bifasciatus* Fourcroy).

(*Cryptus*) *bifasciatus* SAY, Boston Journ. Nat. Hist., vol. 1, p. 234, 1835; in LeConte, The complete writings of Thomas Say on the entomology of North America, vol. 2, p. 691, 1859.

*Cryptus? bifasciatus* (Say) CRESSON, Trans. Amer. Ent. Soc., vol. 6, p. 209, 1877; Synopsis of families and genera of Hymenoptera of America north of Mexico, p. 183, 1887.

*Exetastes bifasciatus* (Say) CUSHMAN and GAHAN, Proc. Ent. Soc. Washington, vol. 23, p. 163, 1921.

The preoccupation in *Ichneumon* of *bifasciatus* makes necessary a new name for Say's species.

This and *obscurus* Cresson form a group characterized by the very dense fine punctation and vestiture of the head and thorax, thin head, deeply separated and basally strongly convex clypeus, very short antennae especially in the female, and moderately long recurved ovipositor.

*Female*.—Length 11 mm, antennae 8 mm.

Head medially less than half as thick as broad; temples weakly convex and strongly receding; occiput rather broad and moderately concave; frons broadly and rather deeply concave; face nearly flat and with a small prominent median rounded elevation, less than half as long as broad; clypeus deeply separated, half as long as broad, apex strongly rounded and narrowly subtruncate or emarginate medially, basal portion short, convex, apical portion slightly concave; cheeks in front view straight, their extended angle somewhat acute; malar space about three-fourths basal width of mandible; mouth barely broader than face; mandible about twice as long as broad at base and strongly narrowing toward apex; junction of occipital and hypostomal carinae three-fourths the basal width of mandible from the latter; eyes strongly convex, barely as long as width of face, parallel; postocellar and ocellular lines equal and less than twice the diameter of a lateral ocellus; ocelli distinctly before posterior tangent of eyes; antenna rather slender, weakly tapering, with 44–46 joints, basal joint of flagellum much less than twice as long as second joint, middle joints longer than thick, subapical joints very short.

Thorax stout; notauli absent; scutellum subtriangular, strongly convex, less densely punctate than scutum; propodeum strongly convex, medially and posteriorly rugulose, with irregular apical carina most prominent medially and fading out laterally, a longitudinal impression before the carina, pleural carinae more or less distinct

posteriorly, absent anteriorly, spiracles small, elongate, situated far above pleural carinae.

Legs rather slender; hind femur three-fourths as long as tibia; inner hind calcarium hardly reaching middle of basitarsus; tarsus a little longer than tibia, apical joint shorter than third.

Wings: Apical abscissa of radius moderately curved at base, barely a half longer than basal abscissa; second discoidal cell rather broad, basal abscissa of subdiscoideus much less than twice as long as second recurrent, which is subgeniculate above; nervulus postfurcal, strongly inclivous; abscissula much less than twice as long as intercubittella.

Abdomen polished, broad, weakly compressed at apex; first tergite not nearly twice as long as broad at apex; second barely as long as broad at base; ovipositor slightly recurved, sheath a little longer than first tergite.

Ferruginous with thorax ventrally and sometimes in sutures more or less black; flagellum blackish at base and apex, paler below at base, with a yellowish annulus at about joints 8-13; hind tibia at apex and basitarsus more or less fuscous, joints 2-4 of tarsus more or less yellowish; wings infumate, front wing with a transverse band below parastigma and base of stigma and a triangular spot beyond stigma hyaline; basal half of stigma yellow, apical half black; ovipositor sheath black.

*Male*.—Malar space barely half basal width of mandible; ocelli larger; antennae slender, as long as body, all joints longer than thick; apical carina of propodeum more distinct; abdomen more slender, first tergite nearly twice as long as broad at apex. Face, clypeus, and mandibles yellow; occiput entirely, vertex and frons medially, black; thorax more extensively black; scutellum yellow; hind tibia broadly at apex and basal and apical joints of tarsus, black; wings hyaline, stigma largely black.

*Type locality*.—Indiana.

*Type*.—Lost.

*Remarks*.—A considerable series including both sexes is before me from Washington, D. C., Georgia, Florida, Alabama, and Texas as well as Jicoltepec and Baja California, Mexico.

Included are eight females and three males reared under Webster no. 4606, from *Feltia malefida* Guenée at Mercedes, Tex., by T. D. Urbahns late in April and early in May 1909; one female reared under Chittenden no. 1057, from a noctuid at Brownsville, Tex., by D. K. McMillan on May 25, 1908; one female reared from *Agrotis* sp. on cabbage at Brownsville, Tex., by D. K. McMillan on January 9, 1909; one female reared from "cutworm", April 4, 1911, at Lyford, Tex.; one male from Bradenton, Fla., February 17, 1927, Truck Crop no. 3565, C. O. Bare. Included in the series are specimens in the collection of Kansas University.

## 18. EXETASTES OBSCURUS Cresson

PLATE 18, FIGURE 44; PLATE 21, FIGURE 110

*Exetastes decoloratus* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 280, 1865; male. New synonymy.

*Exetastes obscurus* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 281, 1865, female.—CUSHMAN, in Leonard, Insects of New York, p. 932, 1928.

*Exetastes fascipennis* HOWARD (not Cresson), Insect book, pl. 10, fig. 7, 1903.

Very closely allied to *bifenestratus* but immediately distinguishable in the female by the paler, at most faintly fasciate wings. Differing also from the above description of *bifenestratus* as follows:

*Female*.—Cheeks in front view slightly convex, their extended angle nearly right; malar space as long as basal width of mandible; junction of occipital and hypostomal carinae distant from base of mandible only about half width of latter; eyes slightly shorter than width of face; antenna shorter, stouter, and more tapering, about 50-jointed, basal joint of flagellum twice as long as second, middle joints as thick as long; propodeum almost without trace of apical carina and longitudinal groove.

Occiput, frons below, coxae basally and within, trochanter above, and femora above frequently more or less black or piceous; flagellum except annulus entirely black, the annulus frequently obscure; wings nearly hyaline with at most faint indications of fasciae; stigma entirely pale.

*Male*.—Malar space shorter (somewhat more than half as long as basal width of mandible); ocelli larger; antennae longer with subapical joints longer than thick; apical carina of propodeum indicated medially. Black of head and thorax more extensive; head otherwise largely yellow.

*Type locality*.—Colorado.

*Type*.—Of *obscurus* no. 1609 and of *decoloratus* no. 1616, Acad. Nat. Sci. Philadelphia.

*Remarks*.—In addition to the types the material examined includes specimens from the Atlantic States from Massachusetts to South Carolina, and from Ohio, Manitoba, and Oregon. Both sexes, especially the male, exhibit wide variation in color, three males that I somewhat doubtfully include having the entire thorax, except the yellow scutellum and two ferruginous spots on the propodeum, black, and the legs also more extensively black. About half the females and several males lack most of the black color of the legs.

All specimens, except those from Manitoba and Oregon, which bear dates in September, were taken in October and November. Three females and one male were reared from *Porosagrotis vetusta* Walker at The Dalles, Oreg., by L. P. Rockwood, September 26 to October 4, 1928. Part of the material studied is in the Canadian National Collection and the American Museum of Natural History.

## 19. EXETASTES CALLIPTERUS, new species

Very similar in general appearance to *bifenestratus*, but much larger with head and clypeus of different form, punctuation of thorax coarser and less dense, and differing also by many other characters.

*Female*.—Length 15 mm, antennae 9 mm.

Head much less than twice as broad as thick, the occiput deeply concave, temples short but rather strongly convex, finely and rather densely punctate; frons more closely punctate, broadly concave; face rather flat with a low median elevation, less than twice as long as broad; clypeus more than half as long as broad, much narrower than face, distinctly emarginate at apex, basal portion weakly convex, fully as long as apical portion, which is separated largely by difference in sculpture; cheeks in front view nearly straight, their extended angle nearly right; malar space slightly more than half as long as basal width of mandible; mouth much broader than face; mandible nearly twice as long as broad at base, only slightly narrowing toward apex, lower tooth larger and longer than upper; junction of occipital and hypostomal carinae fully three-fourths basal width of mandible from the latter; eyes unusually long, nearly twice as long as broad, moderately convex, distinctly longer than width of face, weakly convergent below; postocellar line slightly shorter than ocellocular line and barely a half longer than diameter of an ocellus; posterior ocelli touching posterior tangent of eyes; antenna very short, slightly thickened in middle, 43-jointed, basal joint of flagellum fully twice as long as second, middle joints as thick as long, subapical joints a little longer than thick.

Thorax shining and rather densely and finely punctate, mesoscutum more finely and very densely punctate, mat, with very short, very dense erect pubescence, almost pilose; notauli lacking; scutellum strongly convex, more coarsely and sparsely punctate than scutum; propodeum confluent punctate, rugulose medially, positions of pleural carinae indicated by difference in sculpture, spiracles rather broad, far above normal position of pleural carinae.

Legs rather slender, hind femur three-fourths as long as tibia; inner hind calcarium fully half as long as basitarsus; apical joint of hind tarsus as long as third.

Wings: Apical abscissa of radius nearly straight at base, more than a half longer than basal abscissa; areolet rather small with long petiole; second discoidal cell rather broad, second recurrent barely two-thirds as long as basal abscissa of subdiscoideus, moderately curved above; nervulus strongly postfurcal and strongly inclivous; abscissula about twice as long as intercubitella.

Abdomen moderately stout, first tergite a little less than twice as long as broad at apex, second fully as long as broad at base; ovipositor nearly straight, sheath distinctly shorter than first tergite.



Almost entirely ferruginous, with small black stains on occiput, prepectus, bases of coxae, and in thoracic sutures; flagellum black above and apically, brownish below with a yellowish annulus occupying joints 8-15; apices of hind femur and tibia and ovipositor sheath black, the last brown at apex; tibiae and tarsi paler, hind tarsus almost yellow; front wing bright yellow with a longitudinal streak below subcosta, a broad fascia opposite stigma and apex, confluent below with the fascia, infumate, the fascia nearly black; hind wing nearly hyaline with apical third dilutely infumate.

*Type locality*.—Douglas, Ariz.

*Type*.—U.S.N.M. no. 51807.

One female taken August 20, 1933, by W. W. Jones.

20. *EXETASTES CRASSISCUPTUS*, new species

PLATE 19, FIGURE 70

This and the next two following species form a very distinct group characterized by very coarse sculpture, concave mesopleurum, ventrally incomplete occipital carina, very long, slender, and apically attenuate antennae, and short ovipositor.

*Female*.—Length 13 mm, antennae 13 mm.

Head broader than thorax, hardly half as thick medially as broad, occiput deeply concave, temples moderately convex and receding, nearly as long as short diameter of eye, rather coarsely and densely punctate; frons concave, confluent punctate, mat; face less than half as long as broad, medially somewhat elevated, coarsely and confluent punctate; clypeus rather weakly separated, much narrower than face, more than half as long as broad, emarginate and usually with a median groove apically, basal portion very short, punctate almost like face, not strongly convex, apical portion finely shagreened, mat; cheeks in front view straight, their extended angle acute; malar space three-fourths as long as basal width of mandible; mouth hardly wider than face; mandible one and three-fourths times as long as broad at base, somewhat narrowed toward apex; occipital carina not reaching hypostomal carina; eyes strongly convex, shorter than width of face, faintly convergent; ocellocular line distinctly longer than postocellar line and more than twice as long as diameter of an ocellus; antenna as long as body, 58-jointed, very slender, attenuate at apex, basal joint of flagellum twice as long as second.

Thorax strongly compressed, the mesopleurum concave below and joining the sternum in a rounded edge; thorax, especially the pleura, very coarsely and densely punctate; notauli absent; mesoscutum more finely and less densely punctate; scutellum small, subtriangular, elevated, precipitate behind, more sparsely punctate; propodeum rather flat, reticulate rugose, more coarsely so laterally and medially, pleural carinae distinct throughout and lateral carinae represented

by more or less distinct irregular ridges, apical carina lacking, spiracles elongate and nearly touching pleural carinae.

Legs slender; hind femur more than three-fourths as long as tibia; inner hind calcarium more than half as long as basitarsus; apical joint of hind tarsus shorter than third.

Wings: Apical abscissa of radius distinctly curved at base, barely a half longer than basal abscissa; areolet shortly petiolate, irregular, recurrent before middle; second discoidal cell rather narrow, basal abscissa of subdiscoideus more than a half longer than second recurrent, the latter strongly curved above; nervulus distinctly postfurcal; abscissula fully twice as long as intercubittella.

Abdomen rather slender, strongly compressed apically; first tergite fully twice as long as broad at apex, petiole flattened and coarsely punctate laterally; second tergite longer than broad at base; ovipositor short, straight, sheath barely half as long as first tergite.

Head and thorax black; apical portion of clypeus frequently brownish or separated from basal portion by a reddish line; mandible usually more or less ferruginous, scape entirely so; flagellum rarely with a distinct incomplete yellow annulus, though frequently with this obsoletely indicated; anterior margin and humeral angles of pronotum, tegulae, mesoscutum, and scutellum ferruginous, the last and the collar sometimes more yellowish; legs ferruginous, coxae more or less black at base, tibiae sometimes yellowish at base, hind tarsus yellowish on middle joints, hind tibia at apex and basitarsus sometimes infuscate; wings dilute yellowish infumate, stigma dark stramineous, veins blackish; abdomen ferruginous; sheath ferruginous, more or less infuscate at base.

*Male*.—Remarkably like the female in structure, sculpture, and color.

*Type locality*.—Vancouver, British Columbia.

*Type*.—U.S.N.M. no. 51808.

*Paratypes*.—Canadian National Collection; Oregon State College of Agriculture.

*Remarks*.—A northwestern species represented by eight females and two males ranging from Alaska to Oregon as follows: The type and another female labeled simply "Vanc."; one female, Fort Wrangell, Alaska, Wickham; one female, Chilcotin, British Columbia, September 1, 1920, E. R. Buckell; one male, Agassiz, British Columbia, May 10, 1932, R. Glendining; one female and one male, Pullman, Wash., May 10, 1894, and May 4, 1899; two females, Corvallis, Oreg., one July 4, 1925, D. G. Gillespie, the other without additional data; and one female without data in the collection of the Oregon State College of Agriculture.

21. *EXETASTES RUGOSUS*, new name

PLATE 16, FIGURE 3; PLATE 17, FIGURE 38; PLATE 18, FIGURES 52, 65; PLATE 20, FIGURES 81, 95; PLATE 21, FIGURE 104

*Exetastes albitarsis* PROVANCHER, Nat. Can., vol. 6, p. 78, 1874 (preoccupied by *albitarsis* Gravenhorst); vol. 11, p. 213, 1879; Petite faune entomologique du Canada . . . , vol. 2, Hymén., p. 385, 1883, female — CUSHMAN, in Leonard, Insects of New York, p. 932, 1928.

Very closely allied to *crassisculptus*, from which it is immediately distinguishable by the black hind coxa and femur. Differs from the above description of *crassisculptus* as follows:

*Female*.—Temples more weakly convex and more strongly receding; eyes barely shorter than width of face, more distinctly convergent; diameter of a lateral ocellus half as long as ocellocular line; scutellum in profile evenly convex, not precipitous behind; abdomen even more slender, first tergite about two and a half times as long as broad at apex, second a half longer than broad at base.

Clypeus entirely black, mandibles usually so; scape usually more or less black; antennal annulus distinct; anterior margin of pronotum only medially ferruginous; mesoscutum with a more or less distinct median black vitta and usually with lateral vittae; scutellum yellow; all coxae entirely, hind femur except more or less at base, apical half of hind tibia, and all but apex of basitarsus black; tibiae basally and hind tarsus except basally yellow; abdomen usually more or less black at apex, this color sometimes extending as far forward as base of fourth tergite.

*Male*.—Virtually like female.

*Type locality*.—Quebec?

*Type*.—Public Museum, Quebec.

*Remarks*.—Material examined includes a female from Axton, N. Y., June 12–22, 1901, "A. D. MacG(illivray) and L. O. H(oward), compared with the type by C. F. W. Muesebeck; 11 other females as follows: One, Hampton, N. H., June 14, 1919, S. Albert Shaw; one, Westford, Mass., June 14, 1914, H. A. Preston (Gipsy Moth Laboratory no. 9761.68); one, labeled simply "Gip. Moth, Lab. 9761.67, June 1"; one, Keene Valley, Essex County, N. Y., June 30, 1917, H. Notman; one, Reading (Mass.?), June 5, 1917; one, Toulon, Manitoba, May 8, 1923, A. J. Hunter; one male, Aylmer, Quebec, June 1, 1924, C. H. Curran; all the above in the United States National Museum; one female, Queens Park, Quebec, June 15, 1925, C. B. Hutchings, and one, Aylmer, Quebec, June 15, 1924, C. H. Curran, from the Canadian National Collection; one, Spencer, N. Y., May 4, and one, Caroline—Harford, N. Y., June 15, 1904, from the collection of Cornell University; and one, Mount Wachusett, Mass., in the American Museum of Natural History.

22. *EXETASTES CONCAVUS*, new species

Very similar structurally to the two foregoing species, but at once distinguishable from both by the entirely black mesoscutum. From the above description of *crassisculptus* it differs as follows:

*Female*.—Malar space slightly shorter; eye as long as width of face; scutellum less strongly elevated, less precipitous behind; nervulus interstitial or nearly so.

Clypeus and mandibles black; scape at most faintly reddish; flagellum without trace of annulus; thorax black with only small humeral angles of pronotum and an indefinite spot on scutellum ferruginous; coxae entirely and hind femur below more or less black; hind tibia somewhat infusate, basitarsus black; first tergite black at base.

*Male*.—Essentially like female, but scape paler, scutellum entirely black, petiole more extensively black.

*Type locality*.—Grant, Park County, Colo.

*Type*.—U.S.N.M. no. 51809.

*Remarks*.—One of each sex, the holotype female taken at 9,000 feet, July 24–29, 1922; the allotype, labeled simply "Colo., C. F. Baker."

23. *EXETASTES MATRICUS* Provancher

PLATE 16, FIGURE 9; PLATE 17, FIGURES 22, 42; PLATE 18, FIGURE 63

*Exetastes matricus* PROVANCHER, Nat. Can., vol. 11, p. 213, 1879, female; Petite faune entomologique du Canada . . . , vol. 2, Hymén., p. 385, 1883, female.

This and the seven following species form a group differing from all the other groups by the form of the scutellum, which is more or less distinctly flattened above, steeply precipitous behind, and more or less distinctly carinately margined laterally at least toward base. In addition the eyes are large, strongly convex and convergent below; the clypeus long, weakly divided into basal and apical portions and apically emarginate; the malar space long; the antennae long and slender and more or less attenuate apically; the legs slender with very long calcaria; the abdomen slender; and the ovipositor straight, the sheath from three-fourths as long to fully as long as first tergite.

*Female*.—Length 12 mm, antennae 10 mm.

Head hardly half as thick medially as broad, occiput moderately concave, temples nearly flat, strongly receding, about two-thirds as long as short diameter of eye, polished, virtually impunctate; frons concave, mat, sparsely punctate; face more than half as long as broad, medially elevated, concave laterally above, mat, densely punctate; clypeus three-fourths as long as broad, distinctly divided by sculpture but rather weakly so by elevation, emarginate and with a more or less distinct median groove apically; head below eyes very narrow, the cheeks straight, their extended angle very sharply acute; malar space three-fourths as long as basal width of mandible; mouth barely broader

than face; mandible more than a half longer than broad at base, narrowed toward apex; junction of occipital and hypostomal carinae distant from base of mandible more than basal width of latter, the lower cheek deeply excavated and the hypostomal carina very high and thin and arched outward; eyes very strongly convex, longer than width of face and distinctly convergent below; postocellar and ocellular lines equal and about twice as long as diameter of a lateral ocellus; antenna nearly as long as body, slender, and rather attenuate at apex, 52- to 54-jointed, basal joint of flagellum fully twice as long as second, the latter two and a half times as long as thick.

Thorax strongly compressed, polished, with rather sparse punctation, coarser on pleura; notauli absent; scutellum subtriangular, distinctly flattened above, precipitous behind, strongly margined to top of apical slope; propodeum finely reticulate rugose above, coarsely so medially, very coarsely longitudinally rugose behind the medially prominent apical carina; pleural carina indicated by marked difference in sculpture of propodeum and of metapleurum; spiracles elongate, situated far above pleural carinae.

Legs slender, rather short, the hind femur not reaching apex of abdomen, fully three-fourths as long as tibia; inner hind calcarium distinctly more than half as long as basitarsus, apical joint of tarsus nearly as long as third joint.

Wings: Apical abscissa of radius moderately curved at base, barely a half longer than basal abscissa; areolet shortly petiolate or subsessile, irregular, with recurrent before middle; second discoidal cell about a half longer on subdiscoideus than broad at apex; second recurrent strongly subangulate above; nervulus shortly postfurcal to interstitial, abscissula about twice as long as intercubittella.

Abdomen polished, slender, strongly compressed at apex; first tergite about two and a half times as long as broad, its sides concavely curved, second tergite longer than broad at base; ovipositor straight, sheath three-fourths as long as first tergite.

Black, with abdomen, except more or less of petiole, and hind femur, more or less, ferruginous; front and middle legs more or less reddish in front; apical three joints of hind tarsus somewhat reddish; sheath black; wings subhyaline, veins black, stigma paler.

*Male*.—Essentially like female, but front and middle femora pale ferruginous, their tibiae and tarsi more yellowish; hind tibia at extreme base and joints 2-4 or 3-4 of tarsus pale yellow; genital sheath largely piceous.

*Type locality*.—Quebec?

*Type*.—Public Museum, Quebec.

*Remarks*.—This is a northeastern species appearing in summer. In addition to a specimen compared with the type by C. F. W. Muese-

beck, the following material has been examined: A large series of both sexes collected by G. S. Walley at Kazubazua, Quebec, on July 26 and 27, 1933; one female, Aylmer, Quebec, on July 20, 1924, H. L. Viereck; one female, Canada, C. F. Baker; one female, West Chop, Mass., July 8, 1893; one female, Forest Hills, Mass., June 22, 1921; and four females, Nantucket, Mass., July 21 to August 17, 1927, C. W. Johnson. Specimens of this species are in the Canadian National Collection and the Boston Society of Natural History.

24. EXETASTES INFUMATRICUS, new species

Very closely related to *matricus*, from which it appears to differ only as follows:

*Female*.—Malar space only two-thirds as long as basal width of mandible; eyes slightly longer; scutellar carinae confined to base; front tibia and tarsus largely, front femur anteriorly, and middle femur apically ferruginous; hind femur not at all black; joints 3 and 4 and apex of joint 2 of hind tarsus yellow; wings deeply infumate.

*Type locality*.—Rochester, Wash.

*Type*.—U.S.N.M. no. 51810.

*Paratype*.—Cornell University.

*Remarks*.—The type captured July 22, 1931, by H. T. Peters; the paratype in Washington, July 25, 1893, by T. Kincaid.

25. EXETASTES ABDOMINALIS Cresson

PLATE 17, FIGURE 21

*Exetastes abdominalis* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 276, 1865; female.

Similar in the high hypostomal carina to *matricus* and *infumatricus*, but in this species the carina is only about half as high as in the others, and the hind femur is black to piceous. Differs further from the above description of *matricus* as follows:

*Female*.—Temples hardly two-thirds as long as short diameter of eyes; hypostomal carina hardly half as high and not arched; antenna (one specimen) with 49 joints; propodeum finely mat and sparsely punctate above, densely punctate laterally, apical areas finely rugulose; pleural carinae indicated by fine foveolate grooves.

Head and thorax blue-black, hind femur piceous to black; joints 3 and 4 of hind tarsus, and sometimes apex of 2, yellow.

*Type locality*.—Colorado.

*Type*.—Acad. Nat. Sci. Philadelphia no. 1612.

*Remarks*.—In addition to the type I have seen only two specimens, both in the United States National Museum, from the C. F. Baker Colorado collection, one compared with the type by myself.

26. *EXETASTES CAERULEUS* Cresson

*Exetastes caeruleus* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 276, 1865; female.

Similar in form and structure to the three preceding species, but with hypostomal carina only moderately high, body, including abdomen, distinctly metallic blue, and legs beyond trochanters largely ferruginous. Compared with the above description of *matricus* it differs further as follows:

*Female*.—Temples distinctly convex, distinctly though sparsely punctate; face and frons more shining, frons nearly flat; junction of occipital and hypostomal carinae about basal width of mandible from base of latter; lower cheek not excavated, the hypostomal carina only slightly higher than normal; propodeum mat, punctate, sparsely so above at base, moderately rugulose behind carina.

Body, coxae, and trochanters black with distinct metallic blue reflections; all femora and tibiae ferruginous; front and middle tarsi infusate, basal joint of hind tarsus black, other joints ferruginous; wings rather deeply infumate.

*Male*.—Essentially like female, but with wings subhyaline.

*Type locality*.—Colorado.

*Type*.—Acad. Nat. Sci. Philadelphia no. 1610.

*Remarks*.—In addition to the type I have seen four females and one male: A female homotype compared by myself with the type, Colorado, C. F. Baker; two females, Creede, Colo., 8,844 feet, August 1914, S. J. Hunter (one in collection of Kansas University); one female, Whitehorse, Yukon, June 5, 1923, 1,000 feet, A. K. Kusche (this is in the California Academy of Sciences); and one male from Colorado.

27. *EXETASTES ALTICOLA*, new species

In this species the scutellum is less distinctly flattened and only very briefly margined at base, but it agrees well with all the other key characters of the *matricus* group.

*Female*.—Length 10 mm, antennae broken. Differs from the above description of *matricus* as follows: Temples rather strongly convex and nearly as long as short diameter of eye, distinctly punctate; frons more densely punctate; malar space fully as long as basal width of mandible; junction of occipital and hypostomal carinae distant from base of mandible barely the width of latter; hypostomal carina of normal height and cheek not excavated; eyes less strongly convex and barely as long as superior width of face; antennae (tips broken off); thorax more densely punctate; propodeum mat, densely punctate except at base and in a narrow median area, apical areas somewhat rugulose, apical carina indicated only medially; pleural carina represented by a fine foveolate groove; first tergite barely twice as long as broad at apex; ovipositor sheath as long as first tergite.

Abdomen black; legs beyond trochanters entirely ferruginous; wings more deeply infumate, stigma black.

*Male*.—Malar space slightly shorter than basal width of mandible; ocelli larger; antennae 42-jointed; wings hyaline, stigma brown.

*Type locality*.—Silverton, Colo.

*Type*.—U.S.N.M. no. 51811.

*Remarks*.—One female and two males taken at 12,000 feet, July 8–31, 1903, and one male, Mount Cheam, British Columbia, August 10, 1903.

28. *EXETASTES DILUTIPES*, new species

PLATE 16, FIGURE 14; PLATE 17, FIGURES 20, 39; PLATE 20, FIGURES 82, 97;  
PLATE 21, FIGURE 106

*Female*.—Length 12 mm, antenna 9 mm.

Very similar to *alticola*, but with malar space three-fourths basal width of mandible; propodeum reticulate-rugulose with apical and pleural carinae distinct; basal two joints of hind tarsus fuscous; abdomen more slender. Antennae shorter than in *matricus*, tapering but not attenuate apically, 45- to 48-jointed.

*Male*.—Malar space two-thirds basal width of mandible; ocelli slightly larger; hind tibia at apex, especially on inner side, and third joint of hind tarsus fuscous.

*Type locality*.—Banff, Alberta.

*Type*.—U.S.N.M. no. 51812.

*Allotype*.—Cornell University.

*Paratype*.—California Academy of Sciences.

*Remarks*.—Five females, including the holotype, all taken at the type locality, July 10 to August 10, 1925, by Owen Bryant; and two males, one (allotype) from Maligne Lake, Alberta, July 1–3, 1915, and one from Yellowstone National Park, June 19, 1930, E. Van Dyke.

29. *EXETASTES PURPUREUS*, new species

Except for its bluish or purplish luster and darker wings this species is, in general appearance, almost identical with *matricus*, but the cheeks are not excavated and the hypostomal carina is of normal height. It differs also from the above description of *matricus* as follows:

*Female*.—Malar space slightly shorter; junction of occipital and hypostomal carinae not more than basal width of mandible from base of latter; ocelli somewhat larger; antenna not quite so long, 52-jointed in type; scutellar carinae shorter; propodeum very finely rugulose above and sparsely punctate especially at base, posterior face reticulate rugulose; abdomen slightly stouter, first tergite barely more than twice as long as broad and second barely longer than broad at base.



Wings deeply infumate, veins and stigma black.

*Type locality*.—Siskiyou County, Calif.

*Type*.—U.S.N.M. no. 51813.

Two females.

30. *EXETASTES RUFIPES* Cresson

*Exetastes abdominalis* var.  $\alpha$  CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 277, 1865; female.

*Exetastes rufipes* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 277 (note), 1865; female.

Differs structurally hardly at all from *purpureus*, but the wings are not so dark, the front and middle legs beyond the trochanters are entirely red, and the hind tibia is red at base, this color extending nearly to apex below.

The hitherto undescribed male has the temples more strongly convex, the wings subhyaline, and joints 2-4 of the hind tarsus yellow.

*Type locality*.—Colorado.

*Type*.—Acad. Nat. Sci. Philadelphia no. 1613.

*Remarks*.—In addition to the type, I have seen one female compared with the type and, like the type, from Colorado; and one male from Mount Adams, Wash., June 26, 1932, A. R. Rolfs.

31. *EXETASTES ORNATUS*, new species

PLATE 16, FIGURE 13; PLATE 17, FIGURE 36; PLATE 18, FIGURE 45; PLATE 20, FIGURES 83, 96; PLATE 21, FIGURE 105

The group including this and the next five species is characterized by the unusually small clypeus, which is distinctly narrower than the face, weakly convex and almost without trace of division into basal and apical portions; broad head with large eyes and strongly receding temples; short malar space; long, slender, and apically attenuate antennae; slender abdomen with first tergite nearly or quite three times as long as broad; and unusually short ovipositor sheath.

The present species differs conspicuously from all the others of the group in that the head and thorax are ornamented with yellow and the propodeum and metapleurum in the female are partly ferruginous.

*Female*.—Length 12 mm, antenna 11 mm.

Head much broader than thorax, fully twice as broad as thick medially; temples strongly receding, flat, sparsely punctate; occiput narrow, shallowly concave; frons shallowly concave, densely punctate, with a more or less distinct median groove; face densely punctate, with a rather weak median elevation, less than twice as broad as long; clypeus much narrower than face, much broader than long, weakly convex in profile, weakly divided into basal and apical portions only by difference in sculpture, truncate at apex with neither emargination nor median groove; cheeks in front view very short, their extended angle about a right angle; malar space hardly two-thirds as long as basal width of mandible; mouth almost exactly as broad as face;

junction of occipital and hypostomal carinae distinctly less than basal width of mandible from the latter, hypostomal of normal height; eyes large, strongly convex, much longer than width of face, very slightly convergent below; postocellar line hardly as long as ocellocular line and less than a half longer than diameter of an ocellus; antenna slender, attenuate at apex, 57-jointed, basal joint of flagellum fully twice as long as second, the latter more than twice as long as thick.

Thorax subpolished, sparsely punctate laterally, very weakly so dorsally; notauli absent; mesoscutum unusually flat; scutellum unusually narrow and rather weakly convex in profile; propodeum weakly convex both transversely and longitudinally, with median trace of apical carina, finely and not densely punctate, with a few short longitudinal rugae posteriorly; position of pleural carina indicated by difference in sculpture; spiracle elongate, situated nearly its length from pleural carina.

Legs slender; inner hind calcarium nearly two-thirds as long as basitarsus; apical joint of tarsus shorter than third joint.

Wings: Stigma and radial cell narrow; apical abscissa of radius moderately curved at base, more than a half longer than basal abscissa; areolet oblique; second discoidal cell rather narrow, second recurrent less than two-thirds as long as basal abscissa of subdiscoideus, subangulate above; nervulus shortly postfurcal; abscissula hardly twice intercubitella.

Abdomen very slender, polished, apically compressed; first tergite about three times as long as broad at apex; second nearly twice as long as broad at base; ovipositor short, sheath distinctly less than half as long as first tergite.

Head and thorax black; spot on each side of face, apical portion of clypeus, spot on lower cheek, mandibles, anterior margin of pronotum medially and humeral angles, anterior lateral margins of mesoscutum, scutellum and postscutellum, and a spot below hind wing yellow; antenna black, scape brownish to yellowish in front, flagellum more or less reddish apically and with a broad incomplete yellow annulus; labial palpus white with apical joint piceous; maxillary palpus brownish stramineous; metapleurum largely and propodeum apically ferruginous, the latter more or less yellowish medially; legs ferruginous, front and middle coxae more or less piceous at base, front coxa otherwise and middle coxa at apex and their trochanters below whitish, trochanters above piceous, basal joint of hind trochanter piceous, apical joint mostly whitish, hind femur narrowly and tibia broadly black apically, tarsus basally blackish and apically reddish with joints 2-4 and apex of 1 whitish; wings hyaline, venation black, stigma reddish stramineous; abdomen ferruginous, segments beyond fifth and sometimes apex of fifth black, sheath piceous.

*Male*.—Structurally much like female, but with eyes parallel, malar space less than half as long as basal width of mandible, and the

punctuation of frons and propodeum confluent. Thorax not at all red, the yellow markings larger and embracing also the following: Entire face with extensions along frontal orbits, malar space, entire clypeus, under side of scape and pedicel, propleura, lower anterior margin of pronotum, mesosternum and lower portion of pleura, subalar tubercle, apex of propodeum and of metapleurum, and small spot at upper end of propodeal spiracle; front and middle coxae and trochanters, their femora anteriorly, tibiae largely and tarsi, hind coxa and trochanters below, and hind tibia basally stramineous; hind coxa and trochanter above ferruginous and black; abdomen piceous rather than black at apex.

*Type locality*.—Flint, Ohio.

*Type*.—U.S.N.M. no. 51814.

*Paratype*.—Academy of Natural Sciences of Philadelphia.

*Remarks*.—Three females and four males, the holotype female taken July 5, 1924, by J. O. Pepper; one female, Highspire, Pa., July 12, 1908, W. S. Fisher; the allotype and one other male, Lyme, Conn., June 15, 1918, Wm. Middleton; two males, Ramsey, N. J., June 19 and 28, 1916; and the paratype female from Connecticut in the Academy of Natural Sciences.

### 32. EXETASTES SUBIMPRESSUS, new species

Similar in form of clypeus and slender abdomen as well as in many other respects to *ornatus*, but immediately distinguishable by the entirely black body in the female and the lack of yellow markings dorsally in the male.

*Female*.—Length 12 mm, antennae (broken).

Head slightly broader than thorax, a little more than twice as broad as thick medially; occiput rather deeply concave, temples weakly convex, strongly receding, sparsely and weakly punctate; frons shallowly concave, rather densely punctate; face less than twice as broad as long, densely punctate, roundly elevated medially, concave laterally below antennae; clypeus narrower than face, weakly convex in profile, divided into basal and apical portions only by difference in sculpture; cheeks in front view short, their extended angle slightly acute; malar space a little more than half basal width of mandible; mouth as broad as face; junction of occipital and hypostomal carinae distant from base of mandible by nearly the width of latter; eyes rather strongly convex, slightly convergent below, longer than superior width of face; postocellar and ocellular lines equal and each nearly twice as long as diameter of ocellus; antennae slender (tips gone but undoubtedly attenuate apically and probably with 55–60 joints), first joint of flagellum hardly twice as long as second, which is nearly three times as long as thick.

Thorax shining, with moderately dense punctation, finer and sparser dorsally; notauli broadly impressed throughout; scutellum narrowly triangular, rather weakly convex in profile; propodeum only moderately convex both transversely and in profile, irregularly reticulate rugose, with median trace of apical carina; spiracle elongate, situated about half its length above the distinct pleural carina.

Legs slender; inner hind calcarium distinctly more than half as long as basitarsus; apical joint of tarsus much shorter than third.

Wings: Apical abscissa of radius slightly curved basally, barely a half longer than basal abscissa; second discoidal cell narrow; second recurrent rather weakly curved above and hardly two-thirds as long as basal abscissa of subdiscoideus; nervulus slightly postfurcal; abscissula barely twice as long as intercubittella.

Abdomen slender, strongly compressed apically; first tergite nearly three times as long as broad at apex, second fully a half longer than broad at base; ovipositor short, sheath less than half as long as first tergite.

Body entirely black except reddish apex of clypeus and along sutures of abdomen; antennae black; palpi dark brown; wings faintly stained, venation dark brown; legs black; front and middle femora in front toward apices and hind femur except at apex ferruginous; joints 2-4 of hind tarsus whitish.

*Male*.—Malar space slightly shorter and ocelli slightly larger; antenna 56-jointed; face, clypeus, malar space, and mandibles yellow; maxillary palpi stramineous; apices of propleura, tegulae basally, paired spots on mesosternum, all coxae, and front and middle trochanters beneath yellow; front and middle femora pale ferruginous, their tibiae and tarsi stramineous to yellowish; hind tibia reddish at base; otherwise essentially like female.

*Type locality*.—Beaver Creek, Mont., 6,300 feet.

*Type*.—University of Kansas.

*Allotype*.—Canadian National Collection.

*Remarks*.—One of each sex, the holotype female taken in August 1913 by S. J. Hunter; the allotype male, Waterton, Alberta, July 14, 1923, H. L. Seamans.

### 33. EXETASTES NIGRIBASIS, new species

Structurally almost identical with *subimpressus*, but with abdomen beyond first tergite in female and beyond second in male entirely ferruginous. Antenna in female nearly as long as body, 55- to 58-jointed, attenuate apically. Hind femur entirely ferruginous.

The male differs from the female as does that of *subimpressus* except that the malar space and sternum are entirely black and the front and middle femora are more or less piceous behind.

*Type locality*.—Harney Peak, S. Dak.

*Type*.—U.S.N.M. no. 51815.

*Remarks*.—Two females and one male, the holotype female and allotype male taken at the type locality July 22 and July 21, 1924, respectively; the paratype female, Norquay Mountain Meadows, 5,000–6,000 feet, Banff, Alberta, July 4, 1925, Owen Bryant.

34. *EXETASTES RUFOBALTEATUS*, new species

In general form and structure similar to *subimpressus*, from the above description of which it differs as follows:

*Female*.—Length 10 mm, antennae 9 mm.

Head distinctly wider than thorax and more than twice as broad as thick medially; distance between junction of occipital and hypostomal carinae and base of mandible much shorter than basal width of mandible; eyes very strongly convex; diameter of a lateral ocellus two-thirds as long as postocellar line; antenna slender, apically attenuate, 53-jointed, first joint of flagellum fully twice as long as second; notauli not indicated; propodeum finely irregularly rugulose; spiracles small and situated their length from the obsolete pleural carinae; first tergite fully three times as long as broad at apex.

Black; tergites 2–4 and apex of 1 ferruginous; wings hyaline; front and middle tibiae below and hind tibia at base more or less ferruginous.

*Male*.—Face, clypeus, malar space, mandibles, palpi, under side of scape, apex of propleurum, mesosternum partly, all coxae and front and middle trochanters and femora beneath, front and middle tibiae and tarsi largely, hind tibia at base, hind basitarsus apically, a median stripe on scutellum, a dot on postscutellum, the tegulae, and sometimes paired spots on anterior margin of mesoscutum yellow; fifth tergite also ferruginous; otherwise essentially like female.

*Type locality*.—Glacier Park Station, Mont., 4,800 feet.

*Type*.—U.S.N.M. no. 51816.

*Paratypes*.—Canadian National Collection; Cornell University.

*Remarks*.—Four females and two males; the holotype female without additional data; the allotype and another male, Harney Peak, S. Dak., July 21–22, 1924; one female, Banff, Alberta, August 30, 1922, C. B. D. Garrett; one female, Sudbury, Ontario, 1892; and one female, Carbonate, Columbia River, British Columbia, July 7–12, 1908, 2,600 feet, J. C. Bradley.

35. *EXETASTES ANGUSTUS*, new species

Similar in form and structure to *subimpressus*, from the above description of which it differs as follows:

*Female*.—Face twice as broad as long; eyes more strongly convex and more distinctly convergent; first joint of flagellum fully twice as long as second; notauli not at all defined; pleural carinae of propodeum distinct; first tergite not nearly three times as long as broad; sheath very nearly half as long as first tergite.

Color as in *subimpressus* except that hind femur is entirely black.

*Type locality*.—Banff, Alberta, Norquay Mountain Meadows, 5,000–6,000 feet.

*Type*.—U.S.N.M. no. 51817.

*Paratype*.—Canadian National Collection.

*Remarks*.—Two females, the holotype taken by Owen Bryant, July 20, 1925; the paratype, at Banff, Alberta, August 16, 1922, by C. B. D. Garrett.

### 36. EXETASTES CONVERGENS, new species

*Female*.—Very closely allied to *angustus* and possibly merely a variety of that species, but differing constantly, so far as can be judged from the rather scanty material, in the conspicuously ferruginous legs, this color involving all femora entirely, front and middle tibiae, and basal two-thirds of hind tibia; also the wings are distinctly darker.

*Type locality*.—Colorado.

*Type*.—U.S.N.M. no. 51818.

*Paratypes*.—American Museum of Natural History; Cornell University.

*Remarks*.—Five females, the holotype from the C. F. Baker collection; the National Museum paratypes from Malta, Colo., 9,400 feet, August 4, 1919, and University of Wyoming Camp, Centennial, Wyo., 9,600 feet, July 5, 1929; the American Museum paratype from Tennessee Pass, Colo., 10,500 feet, August 6–8, 1920; and the Cornell University paratype from Oslar, southwestern Colorado, July 17, 1900

### 37. EXETASTES ANGUSTORALIS, new species

PLATE 16, FIGURE 15; PLATE 17, FIGURE 31; PLATE 18, FIGURE 46; PLATE 19, FIGURE 71; PLATE 20, FIGURES 87, 93; PLATE 21, FIGURE 108

*Exetastes fascipennis* (authors, not Cresson) WALSH, Trans. Acad. Sci. St. Louis, vol. 3, p. 147, 1873; female.—PROVANCHER, Additions et corrections au volume II de la Faune entomologique du Canada . . . , p. 92, 1886; female.—VIERECK, in Smith, Insects of New Jersey, p. 618, 1910.—CUSHMAN, in Leonard, Insects of New York, p. 932, 1928.

There is nothing in the descriptions of Walsh and Provancher that does not apply equally well to either *fascipennis* Cresson or *angustoralis*, but both records, as well as the others cited above, are from well outside the known range of *fascipennis* and within that of *angustoralis*.

This and *fascipennis* form a group very easily distinguishable from those that follow it in the present arrangement by the combination of characters employed in the key. The present species is distinguishable from *fascipennis*, as which it has frequently been misidentified, by the distinctly longer malar space.

*Female*.—Length 12 mm, antennae 9 mm.

Head little broader than thorax, though distinctly more than twice as thick, with occiput moderately concave and temples very strongly receding and weakly convex; frons shallowly concave, densely and finely punctate, mat; face somewhat more coarsely punctate, mat, barely twice as broad as long, medially prominent, concave on each side below antennae; clypeus fully three-fourths as long as broad, strongly convex medio-basally, strongly rounded at apex and with a more or less distinct median emargination; cheeks in front view very long, slightly concave, their extended angle very sharply acute; malar space fully as long as basal width of mandible; mouth hardly as broad as face; mandibles rather narrow; distance from junction of occipital and hypostomal carinae to mandible about equal to base of latter; eyes strongly convex, longer than width of face, virtually parallel; ocellular line slightly shorter than postocellar line and barely a half longer than diameter of an ocellus; antenna conspicuously shorter than body, with 48-51 joints, tapering but not attenuate apically, first joint of flagellum hardly twice as long as second which is little more than twice as long as thick, joints immediately beyond middle shorter than thick.

Thorax strongly compressed, mat, densely and finely punctate, especially dorsally; notauli faintly indicated on disk; scutellum strongly convex both transversely and in profile, more sparsely punctate and more shining than rest of thorax; propodeum in profile weakly convex above, with faint trace of apical carina, beyond which it is concavely sloping, punctate-rugulose laterally, reticulate-rugose medially; spiracles rather short oval, situated shortly above the obsolete pleural carinae.

Legs slender; hind femur more than three-fourths as long as tibia; inner hind calcarium more than half as long as basitarsus; apical joint of tarsus shorter than third joint.

Wings: Apical abscissa of radius moderately curved at base, more than a half longer than basal abscissa; areolet somewhat longer on second intercubitus, the other three sides subequal; second discoidal cell rather broad, second recurrent fully two-thirds as long as basal abscissa of subdiscoideus, rather strongly curved or subangulate above; nervulus distinctly postfurcal; abscissula less than twice as long as intercubitella.

Abdomen very minutely and delicately sculptured, with sparse punctuation on first and sides of second tergite, weakly compressed at apex, first tergite twice as long as broad at apex, the sides concavely curved, second tergite slightly longer than broad at base; ovipositor stout, upcurved, sheath three-fourths as long as first tergite.

Ferruginous; occiput, prepectus, and thoracic sutures black; face, clypeus, mandibles, anterior margin of pronotum, and scutellum

paler, sometimes yellowish; antenna black with a broad yellow annulus, scape mostly ferruginous; wings lightly infumate with darker fasciae below apical half of stigma and along basal vein, venation dark brown, stigma and costa pale ferruginous; legs concolorous, coxae more or less black basally, front and middle legs paler in front, hind femur and tibia apically black, tibia at base and tarsus more yellowish; sheath black with apex ferruginous.

*Male*.—Differs from female principally as follows: Head a little thicker, with temples more convex and less sharply receding; antenna as long as body and more slender; propodeum less roughly sculptured, especially medially.

Varies greatly in color, sometimes essentially like female except that head is largely black with face, frontal orbits, clypeus, and mandibles definitely yellow, black of thorax a little more extensive and the paler portions more distinctly yellow, antennal annulus shorter, scape yellow below, and wings hyaline and immaculate. From this it varies to specimens in which the head is black except for large yellow spots on each side of face and the clypeus, thorax except scutellum entirely black, coxae and hind trochanter largely or entirely black, front and middle legs more definitely yellow, hind femur largely piceous, and abdomen more or less black at base. Many males have a well marked color pattern of black and ferruginous yellowish on mesoscutum.

*Type locality*.—Falls Church, Va.

*Type*.—U.S.N.M. no. 51819.

*Paratypes*.—Canadian National Collection; Cornell University; American Museum of Natural History; and the private collections of Henry K. Townes and Andrew R. Park, Jr.

*Remarks*.—This species is widely distributed in the Northeast, specimens being at hand from Quebec, Ontario, and South Dakota, south to North Carolina (Black Mountains) and Kansas, and including the States of Vermont, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Virginia, Illinois, Nebraska, Wyoming, and the District of Columbia. It is an autumn species, and I have taken it in abundance in October and November about young pine trees in northern Virginia. A large series, mostly males, from Ontario and Quebec were taken in September.

The species has escaped description because it has repeatedly been misidentified as *fascipennis*.

38. EXETASTES FASCIPENNIS Cresson

*Exetastes flavitarsis* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 277, 1865; male (preoccupied by *flavitarsis* Gravenhorst).

*Exetastes fascipennis* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 278, 1865; female.



*Exetastes fasciipennis* DALLA TORRE, Catalogus hymenopterorum . . . , vol. 3, pt. 1, p. 71, 1901; female.

*Exetastes cressoni* DALLA TORRE, Catalogus hymenopterorum . . . , vol. 3, pt. 1, p. 70, 1901; male (new name for *flavitorsus* Cresson).

In studying this species I have examined the entire type series of both of Cresson's names including a paratype of each in the United States National Museum, also one other female from Colorado in the collection of the University of Kansas.

*Female*.—From *angustoralis* it differs principally in the malar space being distinctly shorter than basal width of mandible, the cheeks being therefore shorter in front view and with their extended angle somewhat less sharply acute; junction of occipital and hypostomal carinae much less than basal width of mandible from the latter; antenna slightly more slender, the joints immediately beyond middle fully as long as thick; apical half or more of stigma blackish.

*Male*.—Differs from female in much the same way as the male of *angustoralis* differs from its female. All the known males of the present species have the head and thorax black with yellow markings, the face, clypeus, mandibles, malar space, lower cheeks, frontal orbits below, superior orbits, anterior margin of pronotum (sometimes), a mark on each side of mesoscutum anteriorly and scutellum largely yellow. Legs colored as in male of *angustoralis* except that hind femur is largely ferruginous.

*Type locality*.—Colorado.

*Type*.—Of *fasciipennis* no. 1617, of *flavitorsis* no. 1618, Acad. Nat. Sci. Philadelphia.

*Paratype*.—Of *fasciipennis*, U.S.N.M. no. 51257; of *flavitorsus*, U.S.N.M. no. 44733.

### 39. EXETASTES RUFICOXALIS, new species

PLATE 17, FIGURES 17, 25; PLATE 18, FIGURE 54; PLATE 20, FIGURES 90, 102;  
PLATE 21, FIGURE 114

A small species distinct from all the other North American species with black head and thorax and ferruginous abdomen in its bright ferruginous coxae. Structurally also it stands alone in the combination of characters employed in the key.

*Female*.—Length 9 mm, antennae 7 mm.

Head little broader than thorax and little more than twice as broad as thick medially; occiput shallowly concave; temples moderately convex and sharply sloping; frons broadly concave and densely, finely punctate; face densely, finely punctate, barely twice as broad as long, strongly elevated medially and slightly concave laterally; clypeus much narrower than face, two-thirds as long as broad, strongly convex basally, strongly rounded apically and more or less emarginate medially; cheeks in front view slightly convex, their extended angle nearly a

right angle; malar space very nearly as long as basal width of mandible; mouth barely as broad as width of face, mandibles rather narrow; distance between junction of occipital and hypostomal carinae and base of mandible little more than half basal width of latter; eyes moderately convex, longer than width of face, parallel; ocellocular line little longer than diameter of an ocellus and much shorter than postocellar line; antenna 51- to 55-jointed, rather slender, first joint of flagellum distinctly less than twice as long as second, which is hardly more than twice as long as thick, joints of apical third shorter than thick.

Thorax densely and finely punctate, shining; notauli absent; scutellum rather elongate subtriangular, moderately convex, sparsely punctate; propodeum rather weakly convex, reticulate rugulose, apical carina distinct at least medially; spiracles elongate, close to the distinct pleural carinae.

Legs slender, hind femur more than three-fourths as long as tibia; inner hind calcarium more than half as long as basitarsus, apical tarsal joint shorter than third.

Wings: Apical abscissa of radius rather strongly curved at base, fully a half longer than basal abscissa; areolet oblique, the lower angle distinctly apicad of upper angle; second discoidal cell scarcely a half longer on subdiscoideus than broad, recurrent strongly curved or subangulate above; nervulus antefurcal or subinterstitial; abscissula less than twice as long as intercubitella.

Abdomen polished, shallow, rather slender and strongly compressed apically; first tergite distinctly decurved, slightly more than twice as long as broad, sparsely punctate, petiole in dorsal view more or less constricted; second tergite distinctly longer than broad at base; ovipositor straight, strongly compressed, sheath three-fourths as long as first tergite.

Head and thorax black; apex of clypeus, anterior margin and humeral angle of pronotum, and scutellum at apex yellowish or reddish; abdomen and legs ferruginous, hind tibia and tarsus more or less darker, joints 3 and 4 of tarsus yellowish; sheath piceous; wings hyaline, venation dark brown.

*Male*.—Malar space slightly shorter; ocelli slightly larger; antennae as long as body; yellow markings of thorax larger and including apices of tegulae; hind tibia at apex and tarsus definitely black, tarsal annulus more distinctly yellow; otherwise essentially like female.

*Type locality*.—Colorado.

*Type*.—U.S.N.M. no. 51820.

*Paratypes*.—Canadian National Collection; Cornell University.

*Remarks*.—Nineteen females and 16 males ranging from Colorado and Alberta, west to Utah, Idaho, Washington, and British Columbia,

and including a series of 7 females and 5 males without locality but probably from Nevada. It is an autumn-flying species, most of the collection dates being in September.

40. *EXETASTES ZELOTYPUS* Cresson

PLATE 16, FIGURE 12; PLATE 17, FIGURE 40; PLATE 18, FIGURES 50, 68; PLATE 21, FIGURE 112

*Exetastes zelytypus* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 370; female, male.

This and the three next following species form a group characterized by short, stout antennae, strongly pectinate claws, black head and thorax, usually with largely ferruginous abdomen, and deeply infumate wings.

*Female*.—Length 13 mm, antennae 9 mm.

Head little broader than thorax and only slightly more than twice as broad as thick; occiput broad and rather deeply concave; temples strongly convex, finely and rather densely punctate; pubescence unusually dense; frons shallowly concave, densely punctate; face densely punctate, narrowly and only slightly elevated medially, laterally convex below and concave above, twice as broad as long; clypeus nearly as broad as face, two-thirds as long as broad, the short basal portion strongly convex, the long apical portion flat or weakly concave, apex medially emarginate and with a more or less distinct longitudinal groove; cheeks in front view very short, straight, their extended angle sharply acute; malar space barely half as long as basal width of mandible; junction of occipital and hypostomal carinae distant from mandible by about basal width of latter; mandible more than twice as long as broad at base, not strongly narrowed toward apex; eyes moderately convex, as long as superior width of face, strongly convergent below; postocellar and ocellular lines subequal and about three times as long as diameter of an ocellus; antenna about 45-jointed, stout, rather abruptly tapering at apex, basal joint of flagellum hardly twice as long as second and hardly four times as long as thick at apex, second less than twice as long as thick.

Thorax stout, densely punctate, metapleurum confluent so, rugose below, mesoscutum and scutellum more finely and sparsely punctate and shining; notauli absent; scutellum moderately convex; propodeum moderately convex, reticulate rugose, finely so medially, coarsely so laterally, without trace of apical carinae, spiracles large, elongate, situated more than half their length above the distinct pleural carinae.

Legs rather stout, hind femur three-fourths as long as tibia; inner hind calcarium more than half as long as basitarsus; apical joint of tarsus nearly as long as third joint.

Wings: Apical abscissa of radius strongly curved at base, more than a half longer than basal abscissa; areolet petiolate, second intercubitus much longer than other sides and curved; second discoidal cell broad, second recurrent more than two-thirds as long as basal abscissa of subdiscoideus, strongly curved above; nervulus strongly postfurcal; abscissula much less than twice as long as intercubittella.

Abdomen stout, weakly compressed at apex, first tergite little more than twice as long as broad at apex, second about as long as broad at base; ovipositor straight, sheath a little more than half as long as first tergite.

Head and thorax immaculate black, abdomen ferruginous with petiole black at extreme base, venter ferruginous; coxae, trochanters, front and middle femora largely, apical half of hind tibia, and hind tarsus black, hind femur ferruginous, legs otherwise more or less distinctly testaceous or fuscotestaceous; wings deeply infumate; pubescence of head and thorax dense, conspicuous, and dark cinereous.

*Male*.—Differs very little from female beyond having the wings much paler.

*Type locality*.—San Diego, Calif.

*Type*.—Acad. Nat. Sci. Philadelphia no. 1611.

*Remarks*.—Of this species I have seen four females and one male, all from California. These include the type, a female homotype compared by myself with the type and taken with another female in Los Angeles County by D. W. Coquillett, one female from Claremont (collection of Cornell University), and one male from Walnut Creek, Contra Costa County, April 19, 1913, J. C. Bridwell.

#### 41. EXETASTES ERYTHROGASTER, new species

Very closely related to *zelotypus*, differing structurally from the above description of that species only in its distinctly longer malar space, this in the present species being about three-fourths as long as basal width of mandible in female and only slightly shorter in male.

Both sexes differ from *zelotypus* by having the front and middle legs entirely black except the faintly reddish apices of the femora, the hind leg except femur entirely black, the first tergite and venter largely black.

*Type locality*.—Unknown.

*Allotype locality*.—Corvallis, Oreg.

*Type*.—U.S.N.M. no. 51821.

*Paratype*.—Canadian National Collection.

*Remarks*.—One female (the holotype) without data; and two males, the allotype captured April 24, 1897, and the paratype April 25, 1923, at Oliver, British Columbia, by C. B. D. Garrett.

42. *EXETASTES CONCOLORIPES*, new species

This may prove to be only a color variation of *erythrogaster*, but the limited material at hand shows no intergradation.

The only differences appear to be those of color, the present species having the legs entirely black and the black color of the abdomen involving most or all of the second tergite, and in a paratype male most of the third and part of the fourth.

*Type locality*.—Colorado.

*Type*.—U.S.N.M. no. 51822.

*Paratype*.—Canadian National Collection.

*Remarks*.—One female (in poor condition), the holotype, from the C. F. Baker collection; the allotype male from La Grande, Oreg., 2,800 feet, May 12, 1930, H. A. Scullen; and one paratype male from Waterton Lakes, Alberta, June 19, 1923, J. McDunnough.

43. *EXETASTES COLORADENSIS*, new species

Differs apparently only in color from *concoloripes*, the abdomen being entirely black except in the sutures, where it is reddish piceous.

Like *concoloripes* this may be a color phase of *erythrogaster*, but it seems best until more material is available to treat it as a distinct species.

*Type locality*.—Colorado.

*Type*.—U.S.N.M. no. 51823.

A single female taken by C. F. Baker. Both antennae are broken.

44. *EXETASTES AFFINIS* Cresson

PLATE 16, FIGURE 10; PLATE 17, FIGURE 41; PLATE 18, FIGURE 62

*Exetastes affinis* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 277, 1865; female.

This and the next following species are very similar in general form and color to those of the *zelotypus* group, but are at once distinguishable by the long slender legs and antennae, shorter clypeus, and convex cheeks.

The male referred to this species and described by Provancher<sup>2</sup> certainly does not belong here, nor am I able to recognize it from his description as referable to any species known to me. I strongly suspect that it is not an *Exetastes*.

*Female*.—Length 13 mm, antennae 12 mm.

As in *zelotypus*, except pubescence of head and thorax much shorter and less conspicuous; cheeks in front view convex, their extended angle nearly right; malar space barely half as long as basal width of mandible; clypeus little more than half as long as broad; mandible

<sup>2</sup> Petite faune entomologique du Canada . . . , vol. 2, Hymén, p. 385, 1883.

not more than twice as long as broad at base; eyes rather weakly convex, hardly as long as width of face, weakly convergent below; diameter of ocellus more than half as long as postocellar line; antenna very slender, attenuate at apex, nearly 60-jointed, first joint of flagellum nearly six times as long as thick, all other joints much longer than thick; propodeum with distinct median trace of apical carina; legs slender, claws simple; second recurrent weakly curved above.

Color as in *zelotypus* except hind legs entirely black and front and middle legs more largely so.

*Type locality*.—Colorado.

*Type*.—Acad. Nat. Sci. Philadelphia no. 1614.

*Remarks*.—In addition to the type I have seen four females, one of which, a homotype compared by myself, is from Albert Lake, Oreg., June 17, 1934, Joe Schuh, collector; two taken on snow on Pikes Peak, Colo., July 20, 1901, by Dyar and Caudell; and one taken in Michigan by C. H. T. Townsend.

#### 45. EXETASTES ALTERNATIPES, new species

A small replica of *affinis*, differing only as follows:

*Female*.—Length 10 mm, antennae broken.

Hind femur, except extreme apex, bright ferruginous; tibia, except apical third, dark reddish.

*Type locality*.—Bernadillo County, N. Mex.

*Type*.—U.S.N.M. no. 51824.

A single female taken in May 1896 by B. Brown.

#### 46. EXETASTES DEUTEROMAUROS Dalla Torre

*Exetastes maurus* CRESSON, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 370; female (preoccupied by *maurus* Desvignes).

*Exetastes deuteromaurus* DALLA TORRE, Catalogus hymenopterorum . . . , vol. 3, pt. 1, p. 71, 1901.

The only specimen that I have seen is the type.

Among the black species this is very distinct because of the unusually short stout abdomen and the conspicuously hairy head and thorax.

*Female*.—Head and thorax with dense long erect hair, especially conspicuous on temples; temples weakly convex, strongly receding; face very densely and coarsely punctate, more than twice as broad as long and broader than length of the slightly convergent eyes; clypeus two-thirds as long as broad and about two-thirds as broad as face, strongly convex basally, especially in middle, basal portion densely and coarsely punctate, apical portion also coarsely but more sparsely punctate; cheeks in front view slightly concave, their extended angle acute; malar space fully two-thirds as long as basal width of mandibles; postocellar and ocellocular lines equal and nearly three times as long

as diameter of an ocellus; antenna slender, attenuate apically, fully as long as body, 59-jointed.

Thorax rather densely and coarsely punctate, mesoscutum much less densely so than pleura and shining; mesopleurum rather deeply longitudinally concave below; scutellum strongly convex, narrow triangular; propodeum rugulose, without distinct apical carina.

Legs rather stout, hind femur fully three-fourths as long as tibia; inner hind calcarium less than half as long as basitarsus; apical joint of hind tarsus shorter than third, claws weakly pectinate basally.

Wings: Second recurrent vein nearly straight; nervulus nearly interstitial and slightly reclivous; abscissula less than twice as long as intercubittella.

Abdomen polished, short and broad, first tergite depressed throughout, in dorsal view with sides straight from base to apex, nearly two-thirds as broad at apex as long, sparsely punctate at base; second fully as broad at base as long, sides widely divergent; ovipositor straight, sheath much less than half as long as first tergite.

Black with wings very deeply infumate and slightly paler apically; antennae brownish.

*Type locality*.—California.

*Type*.—Acad. Nat. Sci. Philadelphia no. 1609.

47. *EXETASTES BITUMINOSUS*, new species

PLATE 16, FIGURE 5; PLATE 17, FIGURE 37; PLATE 18, FIGURES 43, 67; PLATE 21, FIGURE 116

*Exetastes rufofemoratus* RILEY and HOWARD (not Provancher), *Ins. Life*, vol. 3, p. 158, 1890.

A very distinct species which, because of its black color with bright red hind femora, has repeatedly been misidentified as *rufofemoratus* Provancher.

*Female*.—Length 15 mm, antennae 14 mm.

Head hardly broader than thorax and barely more than twice as broad as thick medially, occiput broad and moderately concave; temples punctate, slightly convex and receding at about 45°; frons slightly concave, rather densely punctate, mat, the interspaces finely sculptured; face sculptured like frons with punctation somewhat coarser, fully twice as broad as long, concave below each antenna, and somewhat roundly elevated medially; clypeus much narrower than face, nearly twice as broad as long, basal portion short, strongly convex, especially in middle, apex strongly rounded with a more or less distinct median emargination and groove; cheeks in front view straight or faintly convex, their extended angle nearly right; malar space about three-fourths as long as basal width of mandible; junction of occipital and hypostomal carinae much less than basal width of mandible from the latter; mandible less than twice as long as broad

at base; eyes rather shallowly convex, barely as long as width of face, parallel; postocellar and ocellular lines equal and hardly twice as long as diameter of an ocellus; antenna very long, slender, attenuate at apex, with about 80 joints, basal joint of flagellum fully twice as long as second.

Thorax coarsely, densely, partly confluent punctate, shining laterally, mesoscutum more finely and less densely punctate but duller; notauli lacking; scutellum moderately convex, elongate subtriangular, more sparsely and coarsely punctate than scutum; propodeum moderately convex, coarsely reticulate rugose, without apical carina, spiracles elongate, nearly their length above the distinct pleural carinae.

Legs slender; hind femur fully three-fourths as long as tibia; inner hind calcarium more than half as long as basitarsus; apical joint of hind tarsus shorter than third joint.

Wings: Apical abscissa of radius strongly curved at base, hardly a half longer than basal abscissa; second discoidal cell broad, second recurrent fully two-thirds as long as basal abscissa of subdiscoideus, strongly curved above; nervulus interstitial or slightly postfurcal; abscissula not or barely twice as long as intercubittella.

Abdomen unusually long and very shallow, especially at apex, very minutely sculptured, petiole coarsely punctate laterally; first tergite two and a half times as long as broad at apex, second longer than broad at base; ovipositor unusually slender, straight, sheath fully three-fourths as long as first tergite.

Black; usually with whitish annuli on antenna and joints 2-4 of hind tarsus (one female from Illinois lacks both); hind femur except apex pale ferruginous; front legs usually more or less reddish in front; wings infumate, venation black.

*Male*.—Differs from female principally in having the temples more strongly convex; antenna even more slender and with far fewer joints (65-70), entirely black; front and middle femora pale ferruginous, their tibiae and tarsi largely white; apical joint of hind tarsus also white; wings nearly hyaline.

*Host*.—*Agrotis alternata* Grote.

*Type locality*.—Vienna, Va.

*Type*.—U.S.N.M. no. 51825.

*Paratypes*.—Canadian National Collection; Cornell University; Kansas University; collections of A. R. Park, Jr., and F. D. DeGant.

*Remarks*.—Eighteen females and 16 males, the holotype female and four other females collected by myself at Vienna, Va., October 29 and November 2, 1913; one female, Virginia near Washington, D. C., J. C. Bridwell; one female, Gunston Cove, Fairfax County, Va., November 20, 1932, R. A. Cushman; three males (the allotype), Falls Church, Va., October 15, 1913, Wm. Middleton, October 22, 1913,



C. T. Greene; two males, Plummers Island, Md., October 19, 1914, R. C. Shannon, October 6, 1932, G. P. Engelhart; one female, Fluvanna County, Va.; one female, Columbia, S. C., G. F. Atkinson; two females and one male, Harrisburg, Pa., September 20 and October 6, 1923, J. N. Knull; one male, Ocean View, N. J., October 7, 1927, C. H. Ballou; one male, Seaside Park, N. J., October 24, Weiss and West; one male, Ithaca, N. Y.; two males, Blue Hill, Mass., September 20, 1891; two males, Hinckley, Ohio, September 26, 1934, F. D. DeGant; one male, Agricultural College, Mich.; one female, Springfield, Ill.; September 19, 1935, A. R. Park, Jr.; one female, Shades, Ind., November 12, 1927, H. H. Ross; one of each sex reared October 21, 1884, at Washington, D. C., under Bureau of Entomology no. 3355° from *Agrotis alternata* Grote (this is the record published in *Insect Life* under *Exetastes rufofemoratus* Provancher); one female, Hopkins U. S. no. 2525, Cornelia, Ga., November 28, 1903, "crawling in road; temperature below freezing", W. F. Fiske; one female, Willard, Mo., November 26; and one female, Itasca State Park, Minn., September 1927, S. Garthside.

48. *EXETASTES DICHROUS*, new species

*Female*.—Length 14 mm, antennae broken.

Head much more than twice as broad as thick; occiput moderately concave, little broader than vertex; temples nearly flat, strongly receding, finely, sparsely punctate; frons broadly concave, sparsely punctate; face more densely punctate, less than twice as broad as long, medially somewhat elevated, distinctly convex at sides below; clypeus distinctly separated at sides, much narrower than face, fully three-fourths as long as broad, basal portion strongly convex, especially in middle, apical portion flat, apical margin strongly rounded and medially subtruncate; cheeks in front view concave, their extended angle sharply acute; malar space nearly three-fourths as long as basal width of mandible; distance from base of mandible to junction of occipital and hypostomal carinae three-fourths as long as basal width of mandible; mouth hardly broader than face; mandible much more than half as broad at base as long, little more than half as broad at apex as at base; eyes moderately convex, slightly longer than width of face, subparallel; postocellar and ocellocular lines equal and nearly twice diameter of an ocellus; antennae very slender (tips gone).

Thorax shining, evenly, not densely punctate, metapleurum partly rugulose so, mesoscutum and scutellum more sparsely so; notauli absent; scutellum large, strongly convex; propodeum coarsely reticulate rugose, spiracles very long, curved, situated less than their length above the distinct pleural carinae.

Legs very slender; hind femur fully three-fourths as long as tibia; inner hind calcarium more than half as long as basitarsus; apical tarsal joint much shorter than third.

Wings: Apical abscissa of radius moderately curved at base, about a half longer than basal abscissa; second recurrent less than two-thirds as long as basal abscissa of subdiscoideus; nervulus slightly postfurcal; abscissula twice as long as intercubitella.

Abdomen polished, strongly compressed, and very deep apically; first tergite a little more than twice as long as broad at apex, second slightly longer than broad at base; ovipositor short, straight, sheath only about a third as long as first tergite.

Black, with abdomen ferruginous, tergites beyond sixth and apex of hypopygium blackish; wings deeply infumate.

*Type locality*.—Siskiyou County, Calif.

*Type*.—U.S.N.M. no. 51826.

One specimen.

#### 49. EXETASTES CORVINUS, new species

Similar in structure to *dichrous*, but at once distinguishable by its black abdomen.

*Female*.—Length 13 mm, antennae 11 mm.

Differs from *dichrous* as follows: Temples even more strongly receding; face twice as broad as long; malar space two-thirds basal width of mandible; eyes slightly convergent below; antenna 64-jointed, slender, attenuate at apex; propodeum very coarsely reticulate rugose, this sculpture also involving most of the metapleurum.

Abdomen entirely black.

*Type locality*.—Vya, Washoe County, Nev.

*Type*.—Cornell University.

One specimen, July 19, 1927, H. E. Guerlac.

#### 50. EXETASTES FLAVIPENNIS Cresson

*Exetastes flavipennis* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 275, 1865; female.

This and the rest of the species form a group most closely related to the genotype, *fornicator* (Fabricius). They are characterized by receding temples; large convergent eyes; long, weakly divided clypeus; moderately long, usually somewhat concave malar space; long mandibles, only slightly narrowing apically; long slender antennae with from 50 to 60 joints, apically somewhat attenuate in female; evenly, rather densely punctate thorax; usually more or less distinctly impressed notauli; strongly convex, immargined scutellum; rugose propodeum with the rugosity coarser and somewhat elevated medially and with longitudinal and apical carinae more or less indicated; long, rather stout hind legs with femora fully three-fourths as long

as tibiae and inner calcarium fully half as long as basitarsus; simple claws; strongly curved apical abscissa of radius; large obliquely rhomboidal areolet; very strongly curved or subangulate second recurrent; rather long second discoidal cell; smooth, polished, apically compressed abdomen with first tergite at least twice as long as broad at apex; ovipositor short, straight, with sheath not or barely half as long as first tergite; entirely black body, this color including at least the coxae and trochanters and sometimes the entire legs; and more or less distinctly infumate wings.

The present species is distinct from all the others in its bright yellow, apically infumate wings.

*Female*.—Length 15 mm, antennae 13 mm.

Head slightly more than twice as broad as thick; occiput rather deeply concave; temples weakly convex, sharply receding, finely sparsely punctate; frons densely punctate, mat, with a median welt between antennal foramina; face densely and medially confluent punctate, medially longitudinally elevated and with a deep impression on each side below antenna, distinctly less than twice as broad as long; clypeus more than three-fourths as long as broad, divided slightly before middle, weakly by elevation and distinctly by sculpture, apical margin sharply rounded; cheeks in front view slightly concave, their extended angle sharply acute; malar space three-fourths basal width of mandible; mandible twice as long as broad at base, little narrowed toward apex; eyes slightly longer than dorsal width of face, distinctly convergent; antenna 58- to 60-jointed, slightly attenuate at apex, first joint of flagellum barely twice as long as second, joints just beyond middle about as thick as long.

Thorax densely punctate, least densely so and strongly shining on mesopleurum and scutellum; notauli shallow but distinct; propodeum finely reticulate rugose, with more or less distinct lateral median traces of apical carina, and with lateral and pleural carinae indicated; spiracles elongate, situated well above pleural carinae.

Legs rather stout, hind femur barely six times as long as thick, three-fourths as long as tibia; inner hind calcarium distinctly more than half as long as basitarsus, apical joint of hind tarsus nearly as long as third joint.

Wings: Apical abscissa of radius a half longer than basal abscissa, strongly curved at base; areolet oblique rhomboidal, apical angle acute, second recurrent slightly before middle; basal abscissa of subdiscoideus hardly a half longer than second recurrent, the latter strongly curved above; nervulus slightly postfurcal; abscissula twice as long as intercubittella.

Abdomen polished, with only sides of petiole punctate, compressed at apex; first tergite twice as long as broad at apex, second longer than broad at base; ovipositor sheath less than half as long as first tergite.

Body, antennae, and legs black; front femur at apex and tibia throughout anteriorly yellowish, tarsi brownish apically; wings bright yellow, apically infumate, venation yellowish ferruginous.

*Type locality*.—Colorado.

*Type*.—Acad. Nat. Sci. Philadelphia no. 1608.

*Paratype*.—U.S. N.M. no. 44732.

*Remarks*.—In addition to the type series I have seen one female from Poudre River Canyon, Fort Collins, Colo., 6,000 feet, June 20, 1929, Klotz, collector; one from Pollock, Idaho, July 1, 1907, J. M. Aldrich, and one from Meadow Valley, Mexico, C. H. T. Townsend. The above description is based on the three specimens listed above and the National Museum paratype.

51. EXETASTES ANTHRACINUS, new species

*Female*.—Length 16 mm, antennae 12 mm.

Head more than twice as broad as thick; occiput rather deeply concave; temples weakly convex and receding at about 45°, sparsely punctate; frons more densely punctate, especially at sides, scrobes separated by a triangular elevation; face densely punctate, confluent in middle, with a deep impression on each side above; nearly twice as long as broad; clypeus two-thirds as long as broad, base rather strongly convex and densely punctate; cheeks in front view weakly concave; malar space two-thirds basal width of mandible; mandible twice as long as broad at base; eyes very weakly convergent below, slightly longer than dorsal width of face; diameter of lateral ocellus slightly more than half postocellar line; antenna 60-jointed, first joint of flagellum fully twice as long as second, joints beyond middle as thick as long, apex attenuate.

Thorax dorsally densely, laterally more coarsely and sparsely punctate; notauli very faintly indicated on disk; scutellum narrow, strongly convex, densely punctate; mesopleurum shining; more coarsely punctate, the punctures about their diameter apart; metapleurum somewhat more densely punctate; propodeum irregularly rugose, longitudinal and apical carinae indicated.

Legs slender; hind femur three-fourths as long as tibia; inner calcarium slightly more than half as long as basitarsus; apical joint of hind tarsus as long as third.

Wings: Apical abscissa of radius strongly curved at base, less than twice as long as basal abscissa; areolet oblique rhomboidal, recurrent in middle; recurrent strongly curved and subangulate above; abscissula twice as long as intercubitella.

Abdomen polished, strongly compressed at apex; first tergite fully twice as long as broad at apex, punctate laterally at base; second nearly a half longer than broad at base; ovipositor straight, sheath hardly as long as first tergite.

Black; legs black throughout except that front legs are pale anteriorly and all tarsi are brown apically; wings deeply, uniformly infumate.

*Male*.—Except for slightly larger ocelli, shorter malar space, and less attenuate antennae with three or four fewer joints, differing only sexually.

*Type locality*.—Nantucket, Mass.

*Type*.—U.S.N.M. no. 51827.

*Paratypes*.—Boston Society of Natural History.

*Remarks*.—Two of each sex, the holotype female captured July 16, 1926, and the allotype and the male paratype June 23, 1926, by C. W. Johnson, and the female paratype July 12 by A. P. Morse. All are from the type locality.

#### 52. EXETASTES GEMINUS, new species

This species is extremely closely allied to *anthracinus*, perhaps only a southern race of that species, but the nine specimens at hand differ constantly by the key characters, though in practically every other respect they are like *anthracinus*.

*Type locality*.—Swannanoa, N. C.

*Type*.—U.S.N.M. no. 51828.

*Paratypes*.—Kansas University; Emory University, Atlanta, Ga.

*Remarks*.—Nine females; the holotype taken September 23, 1924, by T. B. Mitchell; paratypes, Atlanta, Ga., September 4, 1932, September 23, 1934, and October 2, 1932, P. W. Fattig; Wrens, Ga., August 22, 1930, R. H. Beamer; Venus (1,100 feet), Greenville County, S. C., September 22, 1934, H. K. Townes; three specimens, Batesburg, S. C., August 24, 1930, J. Nottingham.

#### 53. EXETASTES PERSIMILIS, new species

##### PLATE 19, FIGURE 73

Like *geminus* this is perhaps only a geographical race of *anthracinus*, but the temples are distinctly more strongly convex and less strongly receding, forming with the longitudinal axis an angle of distinctly less than 45°; the ocelli are larger, in diameter much more than half postocellar line; the malar space is fully three-fourths basal width of mandible; the punctation of the thorax is distinctly finer and denser; and the front and middle legs are reddish piceous rather than black, with the front legs in female paler reddish in front rather than yellowish, though distinctly pale in male.

The male differs from the female as does the male of *anthracinus* from its female.

*Type locality*.—Boulder, Colo.

*Type*.—U.S.N.M. no. 51829.

*Paratypes*.—Cornell University; University of Arizona.

*Remarks.*—Eight females and two males; the holotype female and another female taken at the type locality by S. A. Rohwer on August 28, 1902, and August 25, respectively; two females from the C. F. Baker collection, Colorado; the allotype male, Wind Cave, S. Dak., July 15, 1924; one female, Jemez Springs, N. Mex., 6,400 feet, September 4, 1916, John Woodgate; one male, South Fork, Eagle Creek, White Mountains, N. Mex., 8,000 feet, August 16, C. H. T. Townsend; and two females, White Mountains, Ariz., July 28, 1926, R. B. Streets.

The New Mexico and Arizona specimens are somewhat smaller than those from Colorado but appear not to differ otherwise.

#### 54. EXETASTES SUAVEOLENS Walsh

PLATE 16, FIGURE 7; PLATE 17, FIGURE 35; PLATE 18, FIGURES 49, 66; PLATE 20, FIGURES 88, 100; PLATE 21, FIGURE 109

*Exetastes suaveolens* WALSH, Trans. Acad. Sci. St. Louis, vol. 3, p. 146, 1873; female, male.—PROVANCHER, Nat. Can., vol. 11, p. 212, 1879; Petite faune entomologique du Canada . . . , vol. 2, Hymén., p. 384, 1883.—DALLA TORRE, Catalogus hymenopterorum, vol. 3, pt. 1, p. 74, 1901.—VIERECK, in Smith, Insects of New Jersey, p. 618, 1910; Hymenoptera of Connecticut, p. 274, (1916) 1917.—GAHAN, Proc. U. S. Nat. Mus., vol. 55, p. 114, 1919.—CUSHMAN, Proc. U. S. Nat. Mus., vol. 64, art. 20, p. 43, 1924; in Leonard, Insects of New York, p. 932, 1928—JOHNSON, Biological survey of the Mount Desert (Maine) region, Insects, p. 132, 1927.

*Paniscus quebecensis* PROVANCHER, Nat. Can., vol. 6, p. 106, 1874.

*Exetastes? niger* DAVIS, Proc. Acad. Nat. Sci. Philadelphia, vol. 21, p. 188, 1894 (preoccupied by *niger* Cresson). New synonymy.

*Exetastes provancheri* DALLA TORRE, Catalogus hymenopterorum, vol. 3, pt. 1, p. 73, 1901. New synonymy.

*Campoplex niger* GAHAN and ROHWER (not Provancher), Can. Ent., vol. 49, p. 335, 1917.

Provancher himself synonymized his *Paniscus quebecensis* with *suaveolens*, and A. B. Gahan's note (in MS.) says "not in Public Museum, Quebec, unless under *Exetastes suaveolens* Walsh. All specimens under this name are the same species."

The name *Exetastes provancheri* Dalla Torre was proposed and comes into the synonymy of *suaveolens* because of the obvious mislabeling of a specimen in the Provancher collection. In his study of the Provancher types Davis found a specimen labeled "*Campoplex niger* Prov." and in his report doubtfully referred this specimen to *Exetastes*. Dalla Torre, finding the name *niger* preoccupied in *Exetastes*, proposed the name *provancheri* and placed *Campoplex niger* Provancher in the synonymy. When A. B. Gahan was studying the Provancher types he evidently found the same specimen that Davis had seen, for he compared with it a specimen of *suaveolens* and pronounced them identical; and Gahan and Rohwer designated the Provancher specimen as lectotype of *Campoplex niger* Provancher. That this specimen can not be the type of *Campoplex niger* is at once

evident when *suaveolens* is compared with the description of *niger*, for it disagrees in almost every particular. In a subsequent reference to *Campoplex niger*, Provancher<sup>3</sup> himself expressed the opinion that it is nothing more than a variety of "*Limneria genuina* Say" (undoubtedly *Casinaria genuina* [Norton]), and still later he<sup>4</sup> actually synonymized it with *genuina*. His type specimen without the original name label is probably among those placed by him under *genuina*. The last-named species agrees entirely with the description of *Campoplex niger*, and the synonymy is doubtlessly correct.

It is obvious, then, that the lectotype designated by Gahan and Rohwer can not serve in that capacity; that *Campoplex niger* Provancher is not synonymous with *Exetastes suaveolens*; that *Exetastes? niger* Davis (not Cresson) and *Exetastes provancheri* Dalla Torre and the lectotype of *Campoplex niger* Provancher must go into synonymy with *suaveolens*; and that therefore *Exetastes provancheri* Dalla Torre can not be accepted as a new name for *Campoplex niger* Provancher, a synonym of *Casinaria genuina* (Norton).

Recognizable immediately by its pale yellow tibiae and tarsi contrasting with the black body and otherwise black legs.

*Female*.—Very similar in size and structure to *anthracinus* as described above, except that the malar space is fully three-fourths basal width of mandible, the ocelli much more than half postocellar line in diameter, antenna with four or five fewer joints, punctuation of thorax somewhat finer and denser, notauli more distinctly impressed, hind femur very slender, inner calcarium much more than half basitarsus, and apical tarsal joint much shorter than third.

Black with all tibiae and tarsi and front and middle femora apically yellow; wings dilutely infumate, paler at base; ovipositor sheath black at base, brown at apex.

*Male*.—Differs from female in the usual way, larger ocelli, shorter malar space, and less attenuate antennae, and also in having the front and middle femora more extensively yellow and the wings usually paler.

*Type locality*.—Of *suaveolens*, Illinois (?); of *quebecensis*, Quebec.

*Type*.—Of *suaveolens*, destroyed; of *quebecensis*, Public Museum, Quebec.

*Remarks*.—Within its range in the Northeastern States and southeastern Canada this is one of the commonest species of the genus. Among about 75 specimens before me the following States and Provinces are represented: New Brunswick, Quebec, Ontario, Manitoba, Maine, New Hampshire, Massachusetts, New York, Michigan, Ohio, Pennsylvania, Maryland, and Virginia. Included in this series are specimens in the Canadian National Collection, American Museum of

<sup>3</sup> Petite faune entomologique du Canada . . . , vol. 2, Hymén, p. 736, 1883

<sup>4</sup> Additions et corrections au volume II de la Faune entomologique du Canada . . . , index, 1889

Natural History, Boston Society of Natural History, Cornell University, California Academy of Sciences, and the collections of H. K. Townes and A. R. Park, Jr.

It is on the wing late in July and in August and, especially in the southern part of its range, as late as the middle of September.

Despite its abundance, only one rearing record is available; a male was reared in September 1892 from a larva of *Cucullia asteroides* Guenée at Canobie Lake, N. H., by George Dimmock.

#### 55. EXETASTES NERVULUS (Say)

The first to recognize this species as an *Exetastes* were Cushman and Gahan.<sup>5</sup> The specimens then identified by them as *nervulus* are here treated as a new variety.

Structurally similar to *suaveolens*, but with the ocelli slightly smaller, the notauli virtually effaced, and the legs, notably the hind femur, somewhat stouter. Distinguishable also by the black hind tibia and the entire absence of black on the front and middle femora.

Except for the slightly larger size of the typical *nervulus*, I have been unable to find any structural characters to distinguish from it *niger* Cresson, *rufofemoratus* Provancher, and *exploratus* Davis. However, the differences in the color of the hind femora and tarsi are too sharp to be ignored, even though bridged by the new variety *intermedius* and by variation within the varietal limits, and I recognize them as color varieties.

The black hind femur of the typical form is approached in the new variety, and the dark wings in *niger* and *exploratus*; in *rufofemoratus* the hind femur is sometimes considerably infusate at apex and on the other side this variety sometimes approaches *exploratus* in the color of the hind basitarsus; while *exploratus* is intermediate in tarsal color between *rufofemoratus* and *niger*, the apical tarsal joints in the last named being sometimes yellowish.

The varieties *nervulus*, *intermedius*, and *rufofemoratus* are northeastern in distribution, while *exploratus* represents the westward extension of the species and *niger* the southwestern extension, the species through its varieties ranging from Nova Scotia to British Columbia and New Mexico and the typical form as far south as North Carolina.

The varieties may be distinguished by the following key:

#### KEY TO VARIETIES OF EXETASTES NERVULUS (Say)

- |  |                                  |
|--|----------------------------------|
| 1. Hind femur black or uniformly more or less deeply piceous.....    | 2                                |
| Hind femur ferruginous, sometimes more or less infusate at apex..... | 3                                |
| 2. Wings deeply infumate; hind femur black; 15 mm.....               | <b>nervulus</b> (Say)            |
| Wings dilutely infumate; hind femur piceous; less than 15 mm.        |                                  |
|  | <b>intermedius</b> , new variety |

<sup>5</sup> Proc. Ent. Soc. Washington, vol. 23, p. 159, 1921.



3. Hind basitarsus yellow, at most slightly infusate basally; wings dilutely infumate..... **rufofemoratus** Provancher  
Hind basitarsus largely or entirely black; wings, at least in female, rather deeply infumate..... 4
4. Hind tarsus with only the basal joint black..... **exploratus** Davis  
Hind tarsus largely or entirely black, at most reddish or yellowish apically..... **niger** Cresson

**EXETASTES NERVULUS** var. **NERVULUS** (Say)

*Banchus nervulus* SAY, Boston Journ. Nat. Hist., vol. 1, p. 246, 1836; in LeCONTE, The complete writings of Thomas Say on the entomology of North America, vol. 2, p. 700, 1859.

Distinguishable from the other varieties by the combination of larger size, dark wings, black hind femur, and entirely yellow hind tarsus.

*Type locality*.—Indiana.

*Type*.—Lost.

*Remarks*.—This form is represented in the material before me by the following specimens: One female, Wallingford, Conn., August 13, 1922, B. A. Porter; one male, Flushing, N. Y.; one male, White Plains, N. Y., August 20, 1921; one female, Troy, N. Y., September 1, 1934, H. K. Townes (in collection of H. K. Townes); one female, Garrett Rock, N. J., September 7, 1927, F. M. Schott; and one male, Pineola, N. C., June 15, 1934, D. L. Ray.

**EXETASTES NERVULUS INTERMEDIUS**, new variety

*Exetastes nervulus* (Say) CUSHMAN and GAHAN, Proc. Ent. Soc. Washington, vol. 23, p. 159, 1921.

*Female and male*.—Very similar to the typical variety but distinguishable by smaller size, paler wings and piceous rather than black hind femur, the last sometimes approaching brownish red.

*Type locality*.—Southwest Harbor, Mount Desert, Maine.

*Type*.—U.S.N.M. no. 51830.

*Paratypes*.—Boston Society of Natural History, American Museum of Natural History, Cornell University, and the collection of the State entomologist at New Haven, Conn.

*Remarks*.—The following specimens: Two females and one male from Mount Desert Island, Maine (Southwest Harbor, July 15, 1918 [type], Bar Harbor, July 3, 1922, and Eagle Lake, July 18, 1919, C. W. Johnson); two males, Princeton, Maine, July 12, 1909, C. W. Johnson; one female, Montreal, Quebec, July 1; one female, Gravenhorst, Muskoka District, Ontario, July 20, 1918; one female, Waubanic, Ontario, July 2, 1915, H. S. Parish; one female, Laurel Lake, near Jacksonville, Vt., July 13, 1934, Harry D. Pratt; one female, Savoy, Mass., July 16, 1909, W. E. Britton; one female, one male, Great Barrington, Mass., June 16, 1915, C. W. Johnson; one female, Bashbush Falls, Mass., June 28, 1912; one female, Canaan, Conn., June

24, 1929; one male, Salisbury, Conn., July 10, 1926, W. E. Britton; one female, Keene Valley, Essex County, N. Y., August 3, 1918, H. Notman; and one male, Newcomb, N. Y., July 5, 1918.

**EXETASTES NERVULUS var. RUOFEMORATUS** Provancher, new combination

*Exetastes rufofemoratus* PROVANCHER, Nat. Can., vol. 9, p. 212, 1877; vol. 11, p. 210, 1879; *Petite faune entomologique du Canada* . . . , vol. 2, Hymén., p. 384, 1883, female.—JOHNSON, Biological survey of the Mount Desert (Maine) region, pt. 1, Insects, p. 132, 1927.

*Female and male*.—Like variety *intermedius* except that the hind femur is bright ferruginous, sometimes more or less infusate at apex. In some specimens this variety varies toward the variety *exploratus* in that the hind basitarsus is slightly infusate at base.

*Type locality*.—Quebec?

*Type*.—Public Museum, Quebec.

*Remarks*.—Like *intermedius* this is a northeastern form, specimens before me having been collected in the following States and Provinces: Nova Scotia, New Brunswick, Quebec, Ontario, Maine, Vermont, Massachusetts, New York, and Illinois. Included are specimens in the Canadian National Collection, Boston Society of Natural History, American Museum of Natural History, Cornell University, and the collection of the State entomologist at New Haven, Conn.

It is in flight from about the middle of June to the middle of August.

**EXETASTES NERVULUS var. EXPLORATUS** Davis, new combination

*Exetastes exploratus* DAVIS, Trans. Amer. Ent. Soc., vol. 24, p. 365, 1897; female, male.

*Female and male*.—Intermediate between the varieties *rufofemoratus* and *niger*. From the former it differs in the somewhat darker wings and the largely black hind basitarsus; and from the latter in the yellow hind tarsus with only the basitarsus black.

*Type locality*.—South Dakota.

*Type*.—Acad. Nat. Sci. Philadelphia no. 177.

*Remarks*.—Originally described from South Dakota and Michigan, this form is represented also by specimens from New Hampshire, Illinois, Wisconsin, North Dakota, and British Columbia. All specimens before me were captured during June, July, and August. The series includes specimens in the Canadian National Collection, American Museum of Natural History, Boston Society of Natural History, Emory University, and the collection of Andrew R. Park, Jr.

**EXETASTES NERVULUS var. NIGER** Cresson, new combination

*Exetastes niger* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 275, 1865; female, male.—DALLA TORRE, Catalogus hymenopterorum . . . , vol. 3, pt. 1, p. 73, 1901; male.

*Arenetra rufipes* DALLA TORRE, Catalogus hymenopterorum . . . , vol. 3, pt. 1, p. 513, 1901; female (part).

It is pointed out elsewhere in this paper that Dalla Torre, through misinterpretation of a statement by Provancher, erred in synonymizing the female of this form with *Arenatra rufipes* Cresson.

*Female and male*.—Differs from the variety *exploratus* only in having the wings somewhat darker and the hind tarsus entirely black or at most with the apical joints pale.

*Type locality*.—Colorado.

*Type*.—Acad. Nat. Sci. Philadelphia no. 1607.

*Remarks*.—Before me are specimens from Alberta, North Dakota, Wyoming, Colorado, and New Mexico, the last from an altitude of 8,000–8,200 feet in the White Mountains. All were captured during July and August. Included are specimens in the Canadian National Collection, Emory University, the American Museum of Natural History, and the collection of Andrew R. Park, Jr.

#### SPECIES NOT SEEN AND NOT INCLUDED IN KEY

##### EXETASTES CAUDATUS (Provancher)

*Banchus caudatus* PROVANCHER, Additions et corrections au volume II de la Faune entomologique du Canada . . . , p. 121, 1886; female.

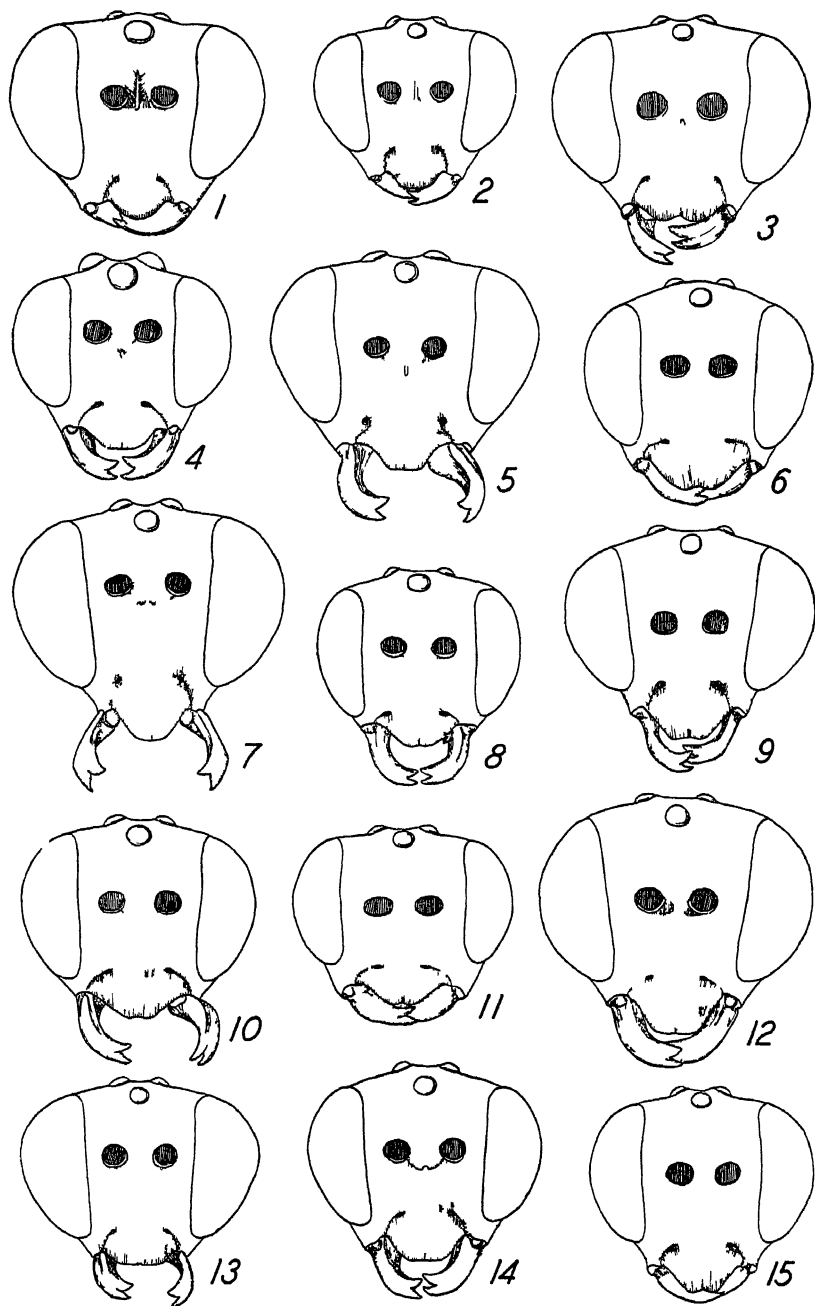
*Exetastes caudatus* (Provancher) DAVIS, Proc. Acad. Nat. Sci. Philadelphia, vol. 21, p. 189, 1894.

The type of this species had been examined by both A. B. Gahan and C. F. W. Muesebeck. Their notes together with the original description suggest that the species is probably allied to *scutellaris* Cresson. Both Gahan and Muesebeck noted the broad temples characteristic of the *scutellaris* group. Within this group the short malar space, as noted by Muesebeck, and the length of the ovipositor and the hyaline wings recorded by Provancher throw it closest to *scutellaris*.

*Type locality*.—Anaheim, Calif.

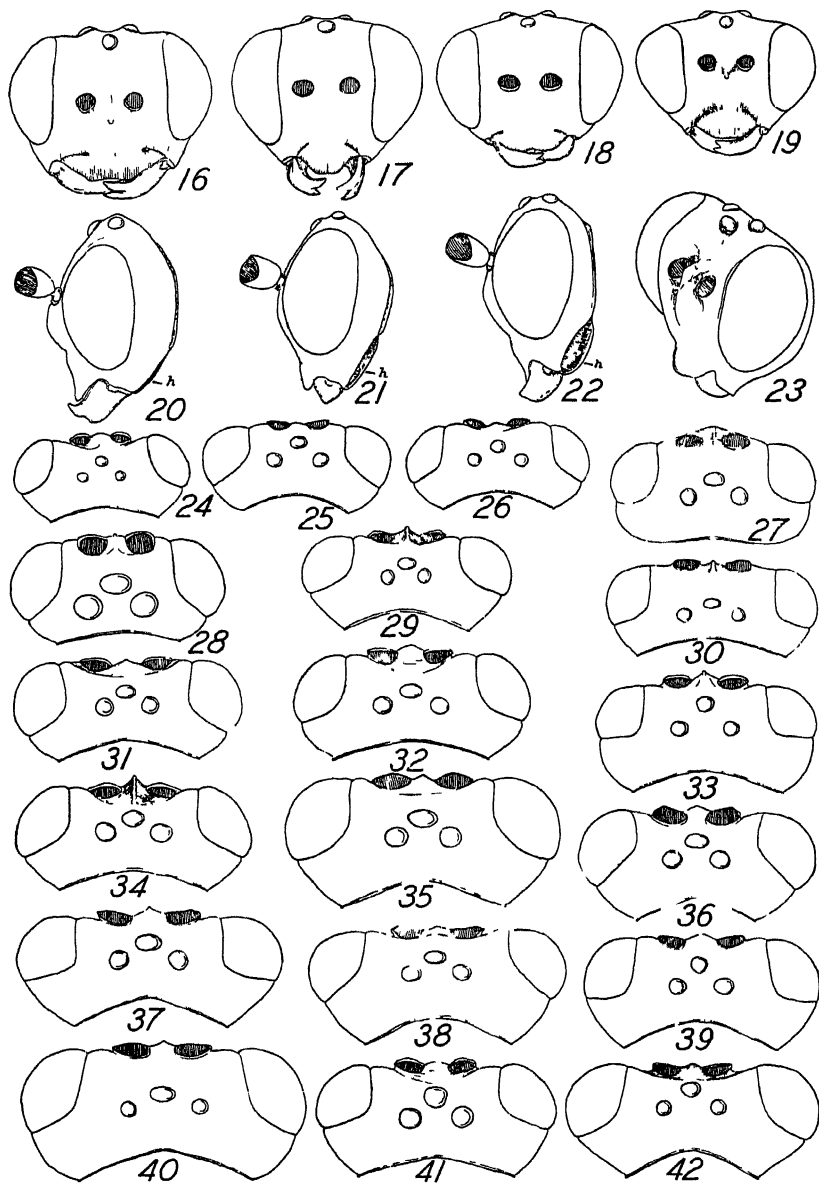
*Type*.—Public Museum, Quebec.

I have not seen the type nor have I been able to identify the species.



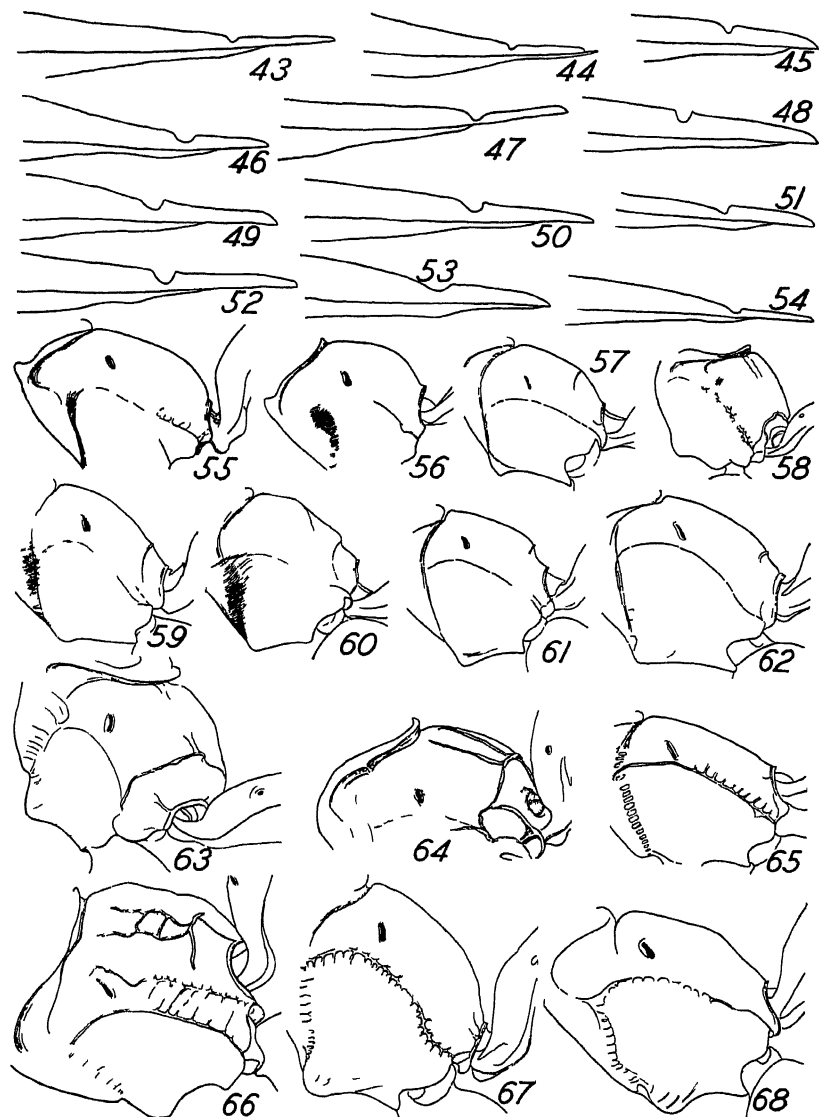
## HEADS OF EXETASTES

1 *carinatifrons* 2 *septum* 3 *rugosus* 4 *flavus* 5 *buluminosus* 6 *ignipennis* 7 *suavicolens* 8 *propinquus* 9 *matricus* 10 *affinis* 11 *bifenestratus* 12 *zelotypus* 13 *ornatus* 14 *dilatipes* 15 *angustoralis*



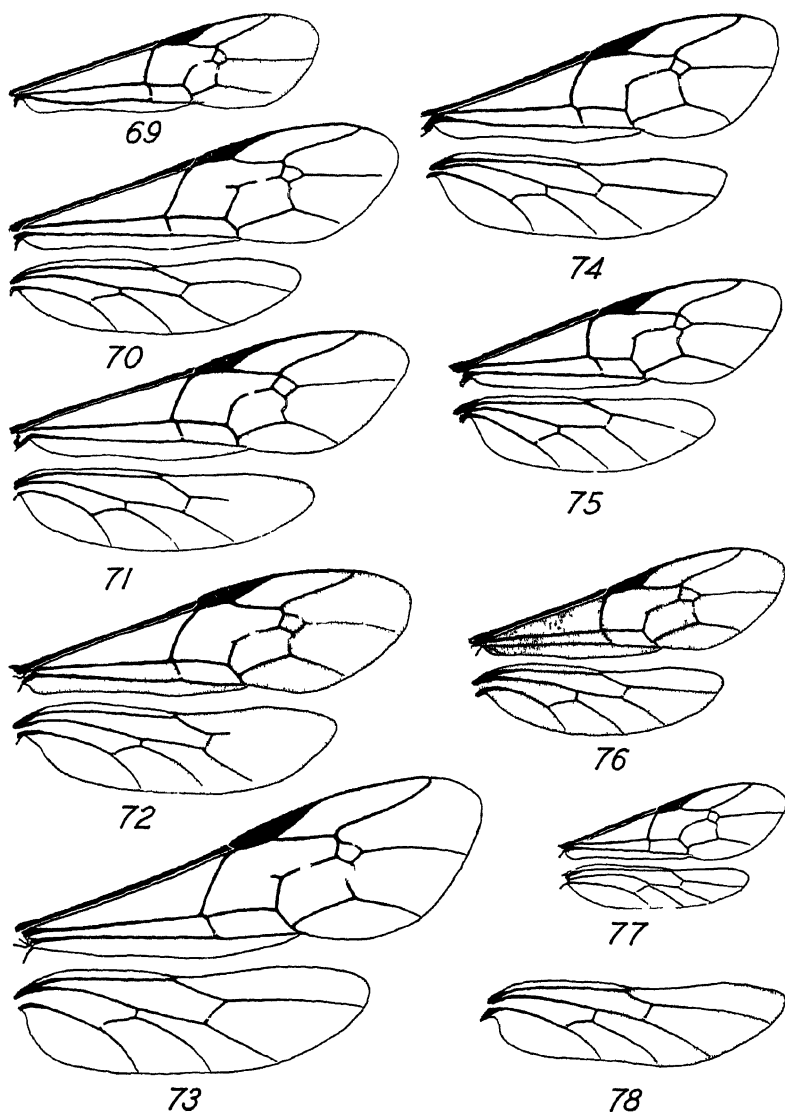
## HEADS OF EXETASTES.

16, *lasius*; 17, *ruficozalis*; 18, *illinoiensis*; 19, *bioculatus*; 20, *dilutipes* (h=hy postomal carina). 21, *abdominalis*; 22, *matricus*; 23, *carinalifrons*; 24, *bioculatus*; 25, *ruficozalis*; 26, *illinoiensis*; 27, *propinquus*; 28, *flavus*; 29, *septum*; 30, *lasius*; 31, *angustioralis*; 32, *bifenestratus*; 33, *igneipennis*; 34, *carinalifrons*; 35, *suarcolens*; 36, *ornatus*; 37, *bituminosus*; 38, *rugosus*; 39, *dilutipes*; 40, *zelotypus*; 41, *affinis*; 42, *matricus*.



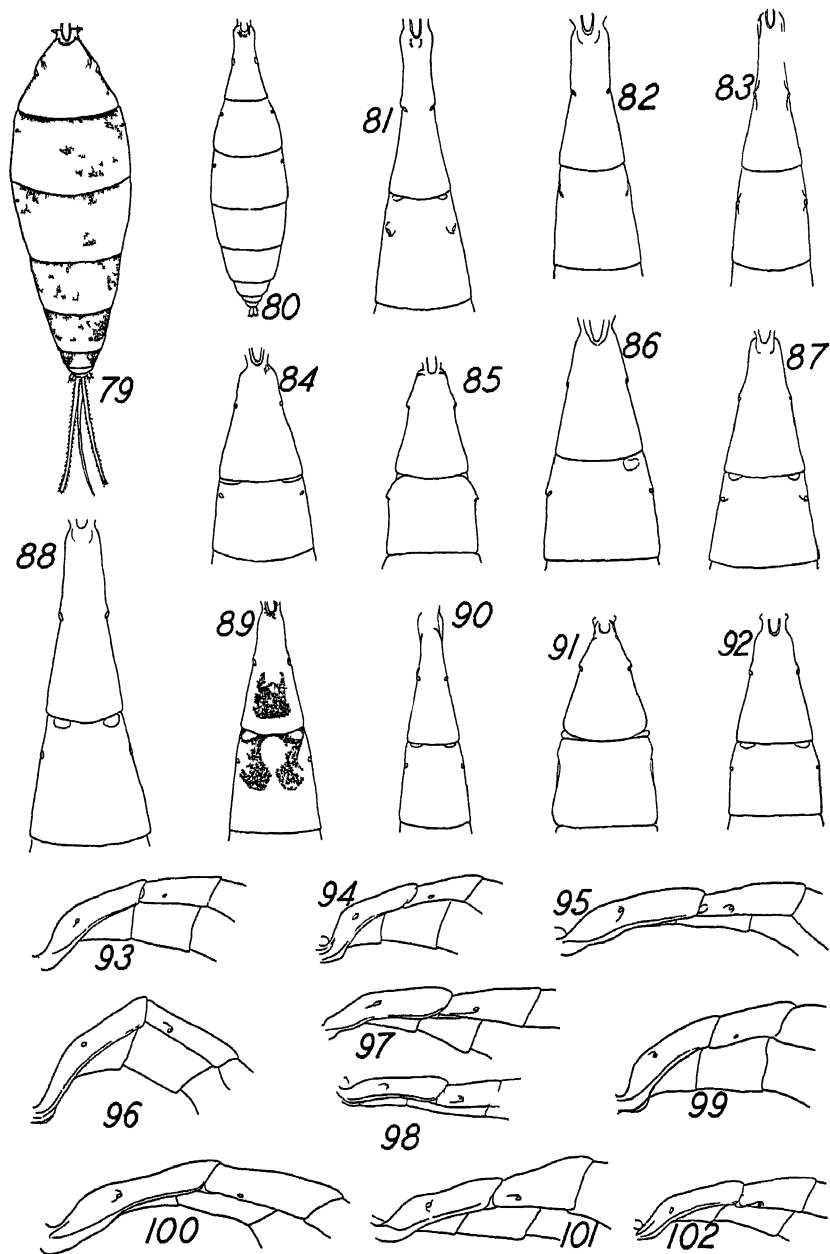
## OVIPOSITORS AND PROPODEA OF EXETASTES

43, *bituminosus* 44, *obscurus* 45, *ornatus* 46, *angustioralis* 47, *pectinatus* 48, *propinquus* 49, *suaveolens* 50, *zelotypus* 51, *septum* 52, *rugosus* 53, *carinatifrons* 54, *ruficozalis* 55, *rudens*, 56, *lasius* 57, *propinquus*, 58, *bioculatus*, 59, *flavus* 60, *ignicipennis* 61, *bifenestratus* 62, *affinis* 63, *matricus* 64, *carinatifrons* 65, *rugosus* 66, *suaveolens* 67 *bituminosus* 68, *zelotypus*



## WINGS OF EXETASTES.

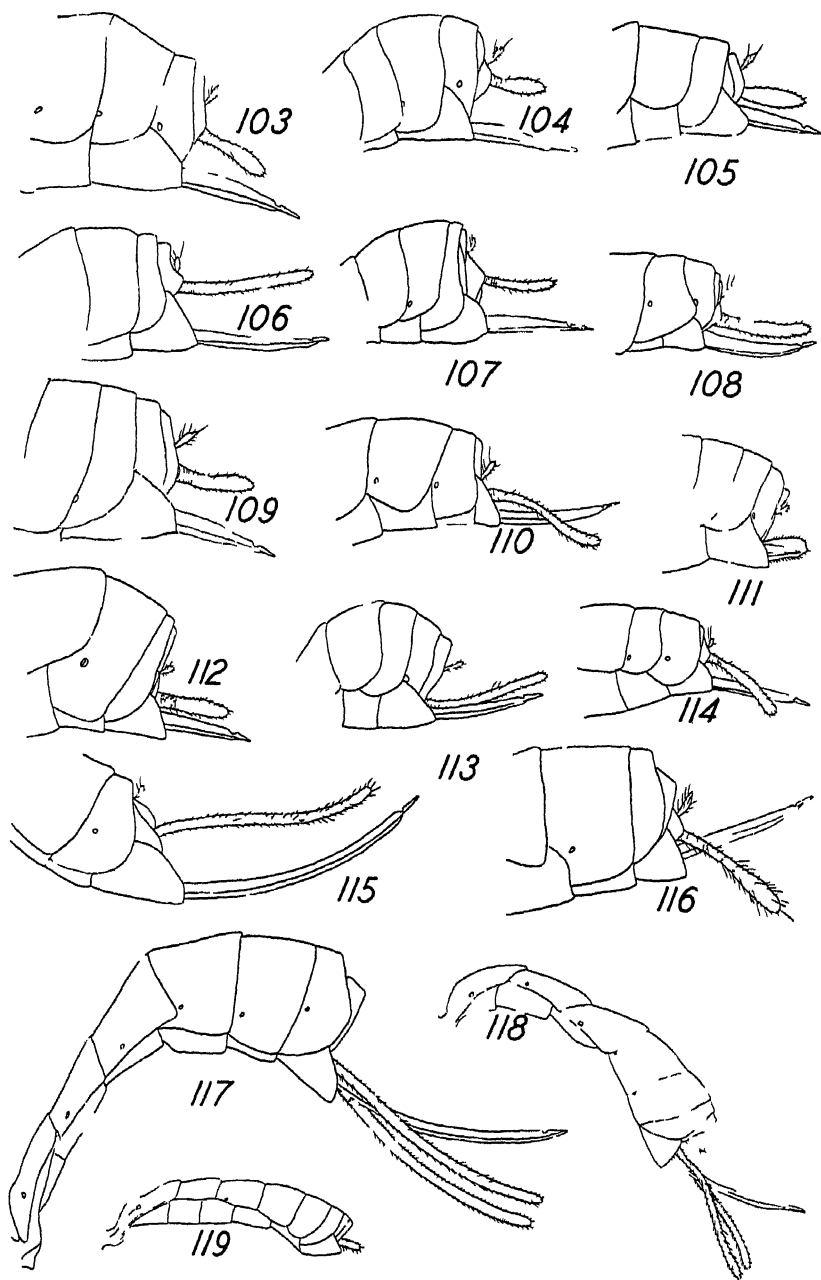
69, *septum*, 70, *crassisculptus*, 71, *angustoralis*, 72, *igneipennis*, 73, *persimilis*, 74, *ridens*, 75, *latus*,  
 76, *bifenestratus*, 77, *bioculatus*, 78, *carinatifrons*



## ABDOMENS OF EXETASTES

79 *lasius*, 80, *bioculatus* 81, *rugosus*, 82, *dilutipes*, 83, *ornatus*, 84, *bifenestratus* 85, *septum*, 86, *igneipennis* 87, *angustoralis* 88, *suaieolens* 89, *flavus* 90, *ruficozalis* 91, *ridens*, 92, *propinquus*, 93, *angustoralis* 94, *bifenestratus* 95, *rugosus* 96, *ornatus* 97, *dilutipes* 98, *propinquus* 99, *septum*, 100, *suaieolens* 101 *igneipennis*, 102, *ruficozalis* (79 and 80 entire, 81-92 base in dorsal view, 93-102 base in lateral view)





## ABDOMENS OF EXETASTES

103, *persimilis* 104, *rugosus* 105 *ornatus* 106, *dilutipes* 107, *propinquus* 108, *angustioralis* 109 *suavecolus*  
 110, *obscurus* 111, *carinatifrons* 112, *zelotypus*, 113, *septum* 114, *ruficorialis* 115, *pictinatus* 116,  
*bituminosus* 117, *ridens* 118, *lascius* 119 *bioculatus* (Lateral views 103-116 apices 117-119, entire )

1





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## A REVISION OF THE CLAPPER RAILS (*RALLUS LONGIROSTRIS* BODDAERT)

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### INTRODUCTION

THE marsh birds called clapper rails form an interesting group. Relatively little from a taxonomic standpoint has been written concerning them, and most of the literature consists of scattered notes and descriptions of new forms. There has been, so far as the writer is aware, no recent publication that could be considered a thorough-going review of their characters and relationships, except perhaps that in James L. Peters's recent check-list.<sup>1</sup> This, however, is intended to be but a check-list, though including the distribution of the various forms. Apparently the best previous treatment of these rails is that by Robert Ridgway in 1880.<sup>2</sup> About 25 years ago the writer prepared a revision of these rails, which for one reason or another has until now remained unpublished. As several rather unexpected results developed from this study, it seems worth while to put them into print.

For the purpose of this investigation about 500 specimens have been examined, including 21 types, which latter represent nearly all the races. The sources of this material were chiefly the collections of the United States National Museum at Washington, including that of the Biological Survey; the American Museum of Natural History, New York City; the Academy of Natural Sciences of Philadelphia, Pa.;

<sup>1</sup> Check-list of birds of the world, vol. 2, pp 157-160, 1934 Cambridge, Mass

<sup>2</sup> On *Rallus longirostris* Boddaert, and its geographical races. Bull Nuttall Orn Club, vol 5, no 3, pp 133-140, July 1880.

the Museum of Comparative Zoology, Cambridge, Mass.; the Carnegie Museum, Pittsburgh, Pa.; the Field Museum of Natural History, Chicago, Ill.; and the private collections of Dr. Jonathan Dwight, Dr. Louis B. Bishop, Dr. Witmer Stone, J. E. Thayer, and J. H. Fleming. To the authorities of these museums and to the individuals mentioned the writer is much obligated for the use of material. To Dr. Charles W. Richmond, Charles B. Cory, Outram Bangs, Dr. Alexander Wetmore, W. E. Clyde Todd, and particularly to Dr. Herbert Friedmann, the writer is further indebted for other courtesies.

In North, Middle, and South America there are approximately 27 forms of large rails belonging to the genus *Rallus* Linnaeus. These may, in general, be considered to belong to two groups, the king rails (*Rallus elegans*) and the clapper rails (*Rallus longirostris*). They have, however, variously been treated as representing from two to six distinct species, some of these with several subspecies.

The first problem of this investigation was presented in the necessity for determining the number of species involved. Examination shows that *Rallus longirostris* and the other South American forms intergrade completely with *Rallus crepitans* of the Eastern United States, through the forms inhabiting the West Indies and the Eastern United States, when individual variation of the island forms is taken into consideration. Therefore, the latter must be treated as a subspecies of *Rallus longirostris*, along with all the forms inhabiting the West Indies. The same is obviously true of the additional races in South America. Furthermore, when all the races represented by a sufficient series are compared with one another it becomes increasingly evident that none of the forms of the Pacific coast can be trenchantly separated, including *Rallus obsoletus*, *Rallus levipes*, *Rallus beldingi* of Lower California, and the other recently described subspecies from northwestern Mexico and southeastern California. Even the isolated *Rallus tenuirostris* of the Valley of Mexico presents no characters that are not bridged over by individual variation when all the forms are considered. There thus seems to be no alternative to regarding all these as races of a single species. It might be mentioned also that none of these overlap in their breeding distribution.

This accomplished, it remains yet to determine the status of the king rail, *Rallus elegans*, of the Eastern United States, and its single subspecies, *Rallus elegans ramsdeni*, of Cuba. This is an unusually difficult matter to decide, and one concerning which there may well be differences of opinion. The chief external characters separating the king rails from the clapper rails consist in the much more reddish bend of the wing, and in the rich rufescent-olive tinge of the upper parts of the former birds, this involving both the centers and margins of the feathers. There is little or no trenchant difference in behavior, voice, nest building, or other habits between these two species.

Neither one of the external characters of plumage above mentioned, nor any difference in size or proportions, is entirely trenchant when all the races of *Rallus longirostris* are included. However, even though individually the two species may apparently intergrade in their characters, they sometimes breed in the same areas, as for instance in Texas, Louisiana, Cuba, and North Carolina, where their ranges, at the edges at least, overlap; and it is interesting to note that in these particular places the characters of the two birds are such as to render them easily distinguishable. For the most part *Rallus elegans* is a fresh-water bird, and *Rallus longirostris* an inhabitant of the salt marshes, but *Rallus elegans* sometimes breeds in salt or brackish areas where also there are clapper rails; and some of the subspecies of clapper rails, such as *Rallus longirostris yumanensis* and *Rallus longirostris tenuirostris* are strictly fresh-water birds. Furthermore, there is in Cuba a subspecies of *Rallus elegans*, known as *Rallus elegans ramsdeni*, although it is separated geographically from the typical *Rallus elegans elegans* by two or three forms that are certainly subspecies of *Rallus longirostris*, these being *Rallus longirostris insularum*, *Rallus longirostris waynei*, and *Rallus longirostris scottii*. The two groups can be separated more or less satisfactorily, however, by the use of a combination of characters, in that *Rallus elegans* presents the combination of a very reddish bend of the wing with a decidedly ochraceous or rufescent tinge on the upper parts, which combination is not found in any form of clapper rail even though each one of these characters may not be separately trenchant. Careful study and comparison are necessary sometimes fully to appreciate these differences, but they are present and are characteristic. In view of the facts above presented it is apparent that we have here what might be regarded as a biological species, and one to which the criterion of intergradation as a test of subspecific relationship is inapplicable. There is a similar case in Europe in the gulls called *Larus fuscus* and *Larus argentatus*; and others, in America, as for instance in some species of flycatchers of the genus *Empidonax*. Under these circumstances it seems best, at least for the present, to consider these birds as representing two species, *Rallus elegans* consisting of two subspecies, and *Rallus longirostris*, made up altogether of 25 races. It is with only the latter that we have to do in the present connection.

In a group as variable racially and individually as the clapper rails, examination and study of the whole group reveal the significance of differences in characters, which sporadic investigations wholly fail to do, and this light enables one to predicate distinctions and separations of subspecies much more safely than would otherwise be the case. The group shows a great tendency to break up into local races, many of which have very limited distribution, which accounts in considerable measure for the recognition of so many forms. The most

valuable characters for subspecific distinction are size and proportions of wing, bill, and other parts, the color of the upper parts, and the color and color pattern of the lower surface. In view of the great individual variation in practically all the forms, comparative descriptions of plumages are of much more value in delineating and identifying the different forms than are detailed descriptions of individual specimens, although the latter are valuable for certain purposes. In making such comparisons, however, the great individual differences of size and color, in nearly all the characters, cause the differences separating the races to be in many cases based on averages; and it is furthermore of much importance in making comparisons between two different races to use birds in the same state of plumage and representing the same color phases.

The range of *Rallus longirostris* as a species extends north to the Northeastern United States and to northwestern California, south to Lower California, central Mexico, Yucatan, and through the West Indies to Peru and southeastern Brazil. None of the 25 subspecies that are here recognized has what might be called a very extended distribution. With the exception of *Rallus longirostris crepitans* and *Rallus longirostris waynei* all the forms are practically resident on their breeding grounds and wander therefrom but little or not at all. The habitat of most of the races is the salt marsh bordering the coast and its inlets, although two of the races, as already indicated, *Rallus longirostris yumanensis* and *Rallus longirostris tenuirostris*, inhabit, so far as known, only fresh-water marshes. Some of the others, however, are occasionally found far back from the coast, to show that they do at times live in fresh-water areas, just as *Rallus elegans* sometimes extends its breeding range over into the salt or brackish marshes. Except in a very general way these birds are not important as indicators of life-zone boundaries, although they have a very interesting connection with ecological associations.

It might be of interest to mention a few of the cases so frequent in plastic species—cases in which a subspecies differs much more in appearance from its nearest geographical neighbors than it does from some far distant relative. For instance, *Rallus longirostris cubanus* resembles much more *Rallus longirostris saturatus* than it does either *Rallus longirostris scottii* or *Rallus longirostris insularum*, although the two latter separate it geographically from the former. Also, *Rallus longirostris waynei* is much closer in appearance to *Rallus longirostris saturatus* than to *Rallus longirostris crepitans*, or even to *Rallus longirostris scottii*. Likewise *Rallus longirostris saturatus* is much more like *Rallus longirostris limnetis* of Puerto Rico than it is to either *Rallus longirostris scottii* or *Rallus longirostris insularum*. Also, *Rallus longirostris insularum* is nearer to *Rallus longirostris saturatus* than to *Rallus longirostris scottii*, and more like *Rallus longirostris*

*limnetis* of Puerto Rico than the intervening *Rallus longirostris cubanus*. In addition, *Rallus longirostris leucophaeus* of the Isle of Pines is much more like *Rallus longirostris corrius* of the Bahama Islands and even nearer *Rallus longirostris waynei* of South Carolina than it is to either the intervening *Rallus longirostris cubanus* or the neighboring *Rallus longirostris caribaeus*. Then, too, *Rallus longirostris pallidus* of Yucatan is much closer to *Rallus longirostris corrius* of the Bahama Islands than it is to any of the intervening West Indian races. The bird inhabiting the Valley of Mexico, *Rallus longirostris tenuirostris*, much more resembles *Rallus longirostris beldingi* of Lower California than it does the intervening *Rallus longirostris nayaritensis*. Finally, and the comparisons could be still farther extended, *Rallus longirostris crepitans* of the coast of the Northeastern United States very much more closely in color approaches *Rallus longirostris corrius* of the Bahama Islands and *Rallus longirostris pallidus* of Yucatan than it does any of the geographically intervening races.

Between the adult male and the adult female of this species there is practically no difference in color. The latter, however, is decidedly smaller in average size. The nestling is when hatched approximately 75–80 mm in length, above jet black with a greenish gloss, below brownish black with a slight greenish gloss anteriorly, but with the abdomen dark blackish clove brown. In some individuals and some races there are slight differences in the color of the lower parts. This plumage is worn until the bird has grown to about twice its original size and the bill to sometimes two and one-half times as long as it was at the beginning. The only color change that takes place during this period is the lightening of the lower surface to clove brown, this then being blackish only anteriorly. The juvenal plumage is similar to that of the adult, but in general differs as follows: The upper surface of the body is plainer and duller with less conspicuous streaking, more like the pattern of the pileum; the sides of the head and neck, particularly the former, are paler, more uniform; the median lower parts are paler, the lower throat, jugulum, and breast with but a trace of ochraceous buff, the throat and jugulum washed also with dull grayish or brownish, often as edgings of the feathers; median portion of breast and abdomen mostly white; sides of the jugulum, breast, and body darker—dull or dark brownish gray, either almost entirely or in the form of edgings of the feathers, producing often a mottled appearance; flanks much paler than in the adult, mouse gray or drab gray with much narrower, less regular, and more inconspicuous whitish bars; and texture of feathers looser than in the adult. The first autumn plumage, which becomes the mature plumage at the end of the first year, is practically identical with that of the adult, but is usually paler below. The last trace of immaturity in plumage is the dusky edgings or mottlings on the sides of the breast, body, and abdomen.



From the black nestling plumage the young bird molts completely into the juvenal plumage, the neossopile feathers being borne on the end of the mesoptiles until worn off, this occurring while the bird is still growing, but these fragile down feathers soon drop off and disappear. This nestling plumage may be observed from early in April to late in August, according to local conditions, and the molt from this plumage takes place from about May to September, being completed from July to late in September.

From the juvenal plumage the bird molts into the first autumn plumage by a feather change practically continuous from the downy stage. By the time the bird's bill, feet, wings, and tail are fully grown, which is accomplished sometime between late August and early October, part of the juvenal plumage is in molt; and by the time the wings and tail are fully grown a portion of the juvenal plumage has already disappeared. The first autumn plumage is thence completed sometime between late August and November, by a molt of all the feathers, except those of the wings and tail, which are still those of the juvenal plumage.

Adults molt but once each year, sometime between May and October, occasionally even beginning in mid-April or extending occasionally to late December, or even to January, and there are specimens showing slight evidence of molt on February 2. The contour feathers begin molting first, and the quills during the process of this change. Seasonal differences in the clapper rails consist in the paling of all the colors of the plumage, both above and below, until they become in summer very much bleached. On account of the character of the habitat of this species the feathers also often become very much tattered by friction against the grass. The general color of the back appears sometimes very dark when the black-centered feathers lose their edges by wear.

Individual variation in this species, particularly in color, is on most of the plumage areas very great. The chin and upper throat vary from pure white to distinctly buff; the width of the white bars on the flanks is also variable; as is the color of the flanks, depth of the cinnamon of the breast and of the other lower parts, and likewise the color of the upper surface. So conspicuous are these differences that they obviously represent color phases. These phases are much more evident in some of the subspecies than in others, being practically absent in some like *Rallus longirostris corrius* and very highly developed in such forms as *Rallus longirostris saturatus* and *Rallus longirostris waynei*. In *Rallus longirostris saturatus*, for instance, there are at least five more or less well-defined color phases that are in no degree due to age, sex, or adventitious condition of plumage, while between these there are all degrees of intermediates. These phases may be briefly described as follows:

(1) *Light gray phase*: In this the feathers of the back and scapulars have medium light, somewhat grayish-brown centers, and broad edgings of clear gray.

(2) *Dark gray phase*: The back and scapulars are much darker, the feathers with very dark brown or blackish centers, the edgings of the feathers much the same as in the light gray phase or somewhat darker.

(3) *Light brown phase*: In this the feathers of the back and scapulars are centrally rather dark but decidedly rufescent brown, and the edgings are light olive brown.

(4) *Dark brown phase*: This is similar to the light brown phase, but the centers of the feathers on the back and scapulars are of a very dark brown or black.

(5) *Gray-breasted phase*: In this very distinct plumage, while the upper parts are like those of the dark brown phase, the whole area of cinnamon on the jugulum and breast is replaced by an almost clear, rather dark gray.

For the names of colors in the following descriptions Ridgway's "Color Standards and Color Nomenclature" (1913) and his "A Nomenclature of Colors for Naturalists" (1886) have been used. All measurements are in millimeters and have been taken in accordance with the recently published manual of measurements,<sup>3</sup> as follows:

*Length of wing*: Measured in a straight line from the bend of the closed wing to the end of the longest primary with these feathers in their natural position, that is, not straightened.

*Length of tail*: Taken with dividers from the point of insertion of the middle pair of rectrices to the tip of the longest, the tail closed.

*Exposed culmen*: Measured in a straight line from the beginning of the feathers on the culmen to the tip of the maxilla, that is, the chord of the exposed culmen.

*Height of bill*: The distance in a straight line from the base of the exposed culmen to the nearest point on the ramus of the mandible below.

*Length of tarsus*: A straight line from the center of the heel joint on the posterior side to the middle of the joint between the metatarsus and the middle toe on the anterior side.

*Middle toe*: Measured along the upper side from the middle of the joint between the metatarsus and the middle toe to the base of the uncovered claw.

All measurements have so far as possible been taken from typical specimens.

<sup>3</sup> Baldwin, Oberholser, and Worley, Measurements of birds. Sci. Publ. Cleveland Mus. Nat. Hist., vol. 2, Oct. 14, 1931.

## RALLUS LONGIROSTRIS LONGIROSTRIS Boddaert

## GUIANA CLAPPER RAIL

*Rallus longirostris* BODDAERT, Table des planches enluminées d'histoire naturelle, p. 52, 1783, after Dec. 1 (based on Daubenton, Planches enluminées d'histoire naturelle, pl. "849. Râle a longuebec [sic], Buff. XV, p. 251" [= "Râle à long Bec de Cayenne" Daubenton, Planches enluminées d'histoire naturelle, pl. 849; Le Râle à Long Bec, Buffon, Histoire naturelle des oiseaux (ed. Deux-Ponts), vol. 15, p. 251; orig. ed., vol. 8, p. 163, 1781 (Guiana)]).

*Subspecific characters*.—Size relatively small; bill relatively stout; upper parts moderately dark and grayish; lower surface light; the white bars on flanks broad and close together; sides of head light brownish; little grayish on foreneck.

*Description*.—Adult, U.S.N.M. no. 70685, Demarara, British Guiana. Pileum and hind-neck broccoli brown, in places somewhat rufescent, mixed with grayish feather edgings, which posteriorly impart a streaked appearance; back and scapulars with the feathers centrally deep sepia brown, marginally lighter and dull gray; rump and upper tail-coverts grayish olive brown, the feathers with sepia shaft markings; tail grayish olive brown, the rectrices bister brown centrally; wing-quills bister, the outer edges, together with the superior wing-coverts, lighter, the inner coverts washed with grayish, the outer ones cinnamon; alula light bister, the outer web of outermost feather margined with cinnamon; sides of head and neck dull ochraceous gray, posteriorly darker and indistinctly streaked with pale brownish gray; supraloral stripe paler, a lengthened spot on lower eyelid dull buffy white; chin and upper throat dull pale ochraceous buff; center of lower throat, whole of jugulum, and breast light cinnamon; abdomen dull cream white; sides of body and flanks rather dark grayish brown, rather broadly barred with white; under tail-coverts white, all but some of the longest barred with grayish brown; lining of wing grayish brown, barred narrowly with white; thighs on outer side drab gray, on inner side dull grayish white partly barred with drab gray.

*Measurements*.—Adult male<sup>4</sup>: Wing, 133–142 (average, 137.5) mm; tail, 52–59 (55.5); exposed culmen, 54–55 (54.5); height of bill at base, 11–13 (12); tarsus, 46.5–47.5 (47); middle toe without claw, 42.5–43.5 (43). Adult female<sup>5</sup>: Wing, 126–131 (average, 128) mm; tail, 47–57.5 (52.7); exposed culmen, 46–53 (49.3); height of bill at base, 11–13 (12); tarsus, 42.5–47 (44.2); middle toe without claw, 41–44 (41.9)

*Type locality*.—Cayenne, French Guiana.

*Geographic distribution*.—Permanent resident from British Guiana to northeastern Brazil.

*Remarks*.—The bill in this race is apparently stouter than in any form of the species except *Rallus longirostris crassirostris*. The few

<sup>4</sup> Two specimens, from Guiana and Brazil.

<sup>5</sup> Four specimens, from French Guiana, British Guiana, and Brazil.

specimens examined indicate that there are at least two color phases in this subspecies. One specimen from Guiana is exceedingly pale below and above; in general appearance very close to *Rallus longirostris crepitans*; and the feathers of the upper parts have very inconspicuous centers. A dark phase is represented by birds from Cayenne and another from Guiana, both of which are more deeply cinnamonaceous below, as well as darker above.

Specimens have been examined as follows:

BRAZIL: Mangunça Island, Maranhão.

BRITISH GUIANA: Demarara.

FRENCH GUIANA: Cayenne.

GUIANA: (Without specific locality.)

**RALLUS LONGIROSTRIS CRASSIROSTRIS** Lawrence

BRAZILIAN CLAPPER RAIL

*R[allus]. crassirostris* LAWRENCE, Ann. Lyc. Nat. Hist. New York, vol. 10, p. 19 (in text), Feb. to Mar. 1871 ("Bahia" [Brazil]).

*Subspecific characters*.—Similar to *Rallus longirostris longirostris*, but bill thicker, upper parts darker, more brownish; sides of head more brownish; anterior under surface much darker, more cinnamonaceous; and the white bars on flanks much narrower.

*Measurements*.—Adult, probable male <sup>6</sup>: Wing, 138 mm; tail, 52; exposed culmen, 52.5; height of bill at base, 15; tarsus, 40.5; middle toe without claw, 46.

*Type locality*.—Bahia, Brazil.

*Geographic distribution*.—Permanent resident in central eastern Brazil, south to southeastern Brazil.

*Remarks*.—The only specimen certainly of this race examined is the type from Bahia, Brazil, which is no. 45660 of the American Museum of Natural History bird collection. It obviously represents, however, a subspecies distinct from the typical form of the species, which inhabits the Guianas and northeastern Brazil.

**RALLUS LONGIROSTRIS CYPERETI** Taczanowski

PERUVIAN CLAPPER RAIL

*Rallus cypereti* TACZANOWSKI (Stolzmann MS.), Proc. Zool. Soc. London, 1877, p. 747, Apr. 1878 ("Santa Luzia", near Tumbes, northwestern Peru).

*Subspecific characters*.—Similar to *Rallus longirostris longirostris* but much smaller, with a shorter and slenderer bill; sides of head more brownish (less grayish); anterior lower parts of a brighter, somewhat darker cinnamon; and white bars on sides and flanks narrower. Similar to *Rallus longirostris crassirostris* but smaller; bill much slenderer; above lighter, more grayish; anterior lower parts of a lighter, rather brighter cinnamon; and the white bars on sides and flanks broader.

<sup>6</sup> One specimen from Brazil, the type.

*Description*.—"Supra olivaceo-griseus fusco maculatus; collo, pectore et striga superciliari flavis; gula abdomineque medio albis; alis caudaque olivaceo-griseis; hypochondriis subalaribusque albo et olivaceo transfasciatis. Rostris brunnei mandibula inferior flavida; pedes olivaceo-carnei; iris rubro-brunnea.

"Forme très-voisine du *R. longirostris*, Vieill. La couleur générale des parties supérieures du corps est d'un gris olivâtre pâle; le dessus de la tête et la nuque sont d'une teinte plus foncée avec des bordures des plumes claires, très-fines et peu distinctes; tout le dos est varié de grosses taches foncées, qui occupent largement le milieu de chaque plume. La gorge est blanche, ainsi que le milieu du ventre; le bas des côtés de la tête, le devant du cou, et la poitrine, ainsi qu'une strie entre la naissance du bec et le bord antérieur de l'œil sont d'une couleur fauve roussâtre claire; un croissant blanc se trouve sur la paupière inférieure dans toute la longueur de l'œil; les côtés du ventre et le bas-ventre sont olive-foncé, striées transversalement de blanc. Les ailes et la queue sont de la couleur du dos; les sus-alaires lavées de roussâtre, les sous-alaires olive-foncé, variées transversalement de raies blanches, fines et peu nombreuses; les plus grandes couvertures inférieures de la queue sont blanches rayées en travers d'olive foncé, les autres blanches en entier. Le bec est brun corné, avec la mandibule inférieure jaunâtre dans sa plus grande moitié basale, ainsi que le bord de la mandibule supérieure; les pattes sont d'une couleur carnée olivâtre; l'iris brun rougeâtre." 7

	♂ millim.	♀ millim.
"Longueur de l'aile pliée	137	125
" de la queue	60	60
" du bec, depuis la commissure	52	51
" du tarse	44	40
" du doigt du milieu	40	37
" de l'ongle	9	8
" du pouce	11	10
" de l'ongle	5	4''7

*Measurements*.<sup>8</sup>—Adult male: Wing, 126 mm; tail, 51; exposed culmen, 52; height of bill at base, 12.8; tarsus, 49; middle toe without claw, 41. Adult female<sup>9</sup>: Wing, 118; tail, 49; exposed culmen, 50; height of bill at base, 10; tarsus, 45; middle toe without claw, 37.

*Type locality*.—Santa Luzia, near Tumbes, northwestern Peru.

*Geographic distribution*.—Permanent resident in the coast region of northwestern Peru (Tumbes) to western Ecuador (Vacquia).

*Remarks*.—This geographically far separated subspecies seems to have, like many other forms of the species, a relatively limited range. In fact, it is known from only two localities. In the color of its upper parts it is practically identical with *Rallus longirostris longirostris*.

<sup>7</sup> Original description from Taczanowski, *op. cit.*, pp. 747-748.

<sup>8</sup> One specimen, from Ecuador.

<sup>9</sup> One specimen, from Ecuador.

**RALLUS LONGIROSTRIS PELODRAMUS, new subspecies**

## TRINIDAD CLAPPER RAIL

*Subspecific characters.*—Similar to *Rallus longirostris longirostris*, but upper parts, including wings and tail, much darker; edgings of dorsal and scapular feathers somewhat more rufescent; lower surface darker.

*Description.*—Type, adult male, J. H. Fleming collection no. 20715; Caroni Swamp, Island of Trinidad, March 16, 1902; Bodington. Forehead, crown, and occiput clove brown, more or less conspicuously but rather narrowly streaked with brownish olive and light brownish olive, the feathers of the forehead with stiff shiny blackish shafts; hind-neck, back, and scapulars warm dark clove brown, much streaked by the broad brownish-olive and light brownish-olive edgings of the feathers; rump and upper tail-coverts warm clove brown, the feathers very broadly margined with olive brown; rectrices warm clove brown, passing laterally into olive brown; primaries and secondaries sepia, rather lighter on their outer margins; tertials dark clove brown, broadly edged with light brownish olive; primary coverts rather grayish sepia; lesser wing-coverts light brownish olive; remaining upper wing-coverts between snuff brown and Saccardo's umber, many of the feathers with ill-defined sepia shaft streaks; alula sepia, the exterior web of outermost feather with more or less dull ochraceous buff along its margin; sides of head grayish buffy brown, passing into grayish olive brown on lores and rictal region; a narrow supra-loral streak dull ochraceous buff, and a lengthened spot on lower eyelid dull buffy white; sides of neck dull buffy brown, obscurely streaked with dull olive brown; chin and upper throat white, with but a suggestion of creamy tinge, laterally dull pinkish cinnamon; jugulum and breast dull cinnamon, laterally much overlaid or mixed with light olive grayish or olive brownish; abdomen dull white; sides and flanks fuscous, heavily barred with white, these bars from 1.5 to 3 mm in width; thighs exteriorly dull pale brownish, interiorly dull buffy whitish; lining of wing fuscous, the axillars rather broadly, the under wing-coverts narrowly, barred with white. "Iris reddish brown; upper mandible and tip of lower, blackish brown; rest of lower mandible pale brownish red; feet brown with darker markings."

*Measurements.*—Adult male <sup>10</sup>: Wing, 131.5 mm; tail, 54; exposed culmen, 51.8; tarsus, 47.5; middle toe without claw, 46.5.

*Type locality* —Caroni Swamp, Island of Trinidad.

*Geographic distribution.*—Permanent resident on the Island of Trinidad.

*Remarks.*—This new race is much different from *Rallus longirostris longirostris*, of Guiana, by reason of its very dark colors, as already

<sup>10</sup> One specimen, the type.

detailed, but it agrees with that form in the stoutness of the bill, in which character it thus differs from all the West Indian, Central American, and North American forms of the species. From *Rallus longirostris crassirostris* it may be distinguished by its rather shorter wing, slenderer bill, wider white bars on sides and flanks, and darker coloration.

The type of this new subspecies is the only specimen that the writer has had opportunity to examine.

**RALLUS LONGIROSTRIS MANGLECOLA Danforth**

**ANTIGUA CLAPPER RAIL**

*Rallus longirostris manglecola* DANFORTH, Proc. Biol. Soc. Washington, vol. 47, p. 19, Feb. 9, 1934 ("Five Islands, Antigua").

*Subspecific characters*.—Similar to *Rallus longirostris longirostris* but larger; bill much longer and slenderer; white bars on sides and flanks narrower; entire upper parts, including wings, tail, and sides of head and of neck, darker; and sides of head more purely grayish.

*Description*.—Brown phase, immature, sex unknown, U.S.N.M. no. 76386, Guadeloupe Island, West Indies; F. A. Ober. Forehead, crown, and occiput rather grayish sepia brown, slightly and obscurely streaked with lighter brown, the feathers of forehead with stiff, shiny, blackish clove brown shafts; upper hind-neck olive brown, somewhat streaked with light drab; lower portion of hind-neck, with all the back and scapulars, between sepia and bister but mostly darker than either, the feathers edged, often broadly, with Saccardo's umber, light brownish olive, grayish olive, light grayish olive, and smoke gray; rump and upper tail-coverts rather deep sepia, the feathers mostly margined with brownish olive; rectrices between bister and sepia, darker medially, and passing laterally into olive brown or buffy brown; primaries and secondaries dark mummy brown, lighter on the latter and on the external margins of primaries; tertials dark brown like the back, broadly edged with Saccardo's umber and light brownish olive; primary coverts mummy brown; greater wing-coverts between bister and sepia or between bister and snuff brown, becoming snuff brown laterally; lesser and median coverts Saccardo's umber, the former with shaft streaks of sepia; alula mummy brown, the exterior web of outermost feather spotted obscurely with dull ochraceous buff; sides of head mouse gray, the lores more brownish, a narrow supraloral streak dull ochraceous buff, and a lengthened spot on lower eyelid dull buffy white; sides of neck rather light olive brown, obscurely streaked with drab gray and buff; chin and upper throat white, with a very faint creamy tinge, laterally pale ochraceous buff; jugulum anteriorly pale ochraceous buff, deepening into pinkish cinnamon posteriorly and on middle of breast, but everywhere somewhat overlaid with light gray;

sides of breast and middle of lower breast and of upper abdomen hair brown (this a remnant of the juvenal plumage); abdomen dull white; sides and flanks hair brown, narrowly barred with dull white; thighs exteriorly between hair brown and drab, interiorly very pale dull grayish buffy or ochraceous white; lining of wing mixed hair brown and snuff brown, passing posteriorly into clear hair brown, and everywhere much narrowly barred with white.

*Measurements*.—Adult male <sup>11</sup>: Wing, 146.1 mm; tail, 60.5; exposed culmen, 73.9; tarsus, 54; middle toe without claw, 50. Adult female <sup>12</sup>: Wing, 135.5; tail, 60.7; exposed culmen, 64.8; tarsus, 45.8. Immature, probable male <sup>13</sup>: Wing, 148; tail, 62; exposed culmen, 64.5; tarsus, 51.5; middle toe without claw, 50.

*Type locality*.—Five Islands, Antigua Island, West Indies.

*Geographic distribution*.—Permanent resident on the West Indian Islands of Antigua and Guadeloupe.

*Remarks*.—This race is similar to *Rallus longirostris pelodramus*, of Trinidad, but is much larger, the bill being much longer and slenderer, the upper parts lighter and more rufescent, the centers of the feathers less blackish (more brownish), and the margins of the feathers there less grayish; the lower parts are lighter, and the center of the jugulum has some gray wash, being not purely cinnamomeous. There are two color phrases involving the color of the upper parts, one gray, the other brown.

A single specimen in fully developed juvenal plumage from the Island of Guadeloupe, collected by F. A. Ober, is apparently the only certain record of the occurrence of a clapper rail on this island. This specimen, though fully grown, still possesses some of the dark juvenal plumage on portions of the breast and abdomen, but otherwise, particularly on the upper surface, it has acquired the full adult livery. Although it exhibits some differences from the average of the other West Indian forms of the species, it seems best, at least for the present, in view of its immaturity, to refer it to *Rallus longirostris manglecola*, which it most closely resembles. It is, however, in the brown phase, and thus differs materially in color from the type of this form. It may, however, be regarded as the brown phase of this subspecies. For purposes of comparison it has been described above.

The following specimens of *Rallus longirostris manglecola* have been seen:

ANTIGUA ISLAND, WEST INDIES: Five Islands (August 10, 1933).<sup>14</sup>

GUADELOUPE ISLAND, WEST INDIES: (No further locality.)

<sup>11</sup> One specimen, the type.

<sup>12</sup> One specimen measured by Danforth, *loc. cit.*

<sup>13</sup> One specimen, from Guadeloupe Island.

<sup>14</sup> Type.



**RALLUS LONGIROSTRIS LIMNETIS, new subspecies****PUERTO RICO CLAPPER RAIL**

*Subspecific characters*.—Similar to *Rallus longirostris manglecola*, but bill and tarsus shorter; upper parts somewhat more grayish (less rufescent), particularly on the lower back; edgings of back and scapulars also paler, giving a rather lighter tone to these parts; and cinnamon of jugulum and breast paler.

*Description*.—Dark phase. Type, adult male, U.S.N.M. no. 232261, Biological Survey collection; Punta Picua, Mameyes, Puerto Rico, February 12, 1912; Alexander Wetmore, original number, 1225. Forehead and crown bister, most of the feathers with stiff, shiny, blackish shafts; occiput sepia; hind-neck olivaceous hair brown, somewhat mixed, particularly on posterior portion, with narrow brownish-gray edgings, which give a somewhat streaked appearance; feathers of back and scapulars centrally varying from clove brown on the scapulars to bister on the rest, marginally smoke gray, brownish gray, or olive gray; rump and upper tail-coverts olivaceous bister, with broad olive or dull olive-gray feather margins; rectrices olivaceous bister brown, darker medially, and more or less broadly edged laterally with olive; primaries and secondaries bister, rather lighter on their margins; tertials like the scapulars, but their centers more blackish; greater wing-coverts rather light bister; their inner webs somewhat more rufescent; median coverts centrally somewhat rufescent clove brown, marginally varying from hair brown to brownish gray; lesser coverts between bister and Saccardo's umber; alula rather light bister, the outer web of outermost feather mottled with cinnamon; sides of head neutral gray, the lores, together with a rather broad continuous stripe below the eyes through the auriculars, grayish hair brown, a lengthened spot on lower eyelid dull grayish white, a narrow supraloral streak pale dull buff; sides of neck and of lower throat between broccoli brown and hair brown, posteriorly inclining to broccoli brown and indistinctly streaked with paler brown; chin and upper throat white, laterally rather deep cream buff; middle of lower throat dull buff; jugulum isabella color; breast between pinkish cinnamon and vinaceous buff, somewhat whitish medially on the posterior portion; abdomen dull white, slightly washed with cream color; sides of body and flanks dark hair brown, rather broadly barred with white; lower tail-coverts white, the middle feathers and also the shorter feathers broadly barred with fuscous; lining of wing anteriorly bister brown, passing posteriorly into blackish fuscous, and narrowly barred with white throughout; thighs interiorly grayish cream color, exteriorly grayish benzo brown. "Iris reddish hazel; culmen and end of lower mandible brown, the base of bill reddish; legs liver color; fore part of tibiae redder" (Newton).

*Downy young*.—"Bill with the under mandible and distal half of the upper as well as an elongated patch over each nostril bright scarlet, the rest livid black" (Newton).

*Measurements*.—Adult male <sup>15</sup>: Wing, 138.5–150 (average, 145.5), mm; tail, 56.5–63.5 (61.2); exposed culmen, 62–68 (63.9); tarsus, 50–56.5 (54.2); middle toe without claw, 47–49.5 (47.4). Adult female <sup>16</sup>: Wing, 136.5–139.5 (137.6); tail, 56–60 (57.7); exposed culmen, 55–60 (58.2); tarsus, 43.5–50 (47.4); middle toe without claw, 41.5–43.5 (42.5).

*Type locality*.—Punta Picua, Mameyes, Puerto Rico.

*Geographic distribution*.—Permanent resident in the West Indian Islands of Puerto Rico, Culebra, Vieques, Tortola, St. Croix, and St. Thomas.

*Remarks*.—This is the West Indian race that apparently most closely approaches *Rallus longirostris longirostris*, but nevertheless its bill is decidedly longer and slenderer than is that of the typical race; the upper parts, including the sides of the head and of the neck, and the upper surface of the wings are darker; and the sides and flanks have narrower white bars.

In *Rallus longirostris limnetis* the jugulum nearly always has more or less gray, although occasionally it is practically absent, this part then being plain cinnamonous.

The birds from St. Thomas appear to be somewhat more brownish (less grayish) on flanks and upper parts, thus verging a little toward *Rallus longirostris caribaeus*, but they are so close to *Rallus longirostris limnetis* that they seem best referred to this race.

So far as our specimens show there are two well-defined color phases in this subspecies—a light phase and a dark phase. There is apparently no gray-breasted or brown phase, notwithstanding the fact that there is great individual variation on the upper parts, though not so much on the lower surface. For purposes of comparison the following description of the light phase may be useful:

Adult male, U.S.N.M. no. 80997; St. Thomas Island, West Indies; F. A. Ober, original number, 34. Forehead and crown brown, between snuff brown and bister, most of the feathers with stiff, shiny, bister shafts; occiput and upper cervix olive brown; rest of hind-neck buffy brown, mixed, particularly on posterior portion, with hair-brown edgings, which impart a somewhat streaked effect; feathers of the back and scapulars centrally varying from buffy brown to olive brown and sepia, marginally smoke gray, light grayish olive, or olive gray; rump and upper tail-coverts olive brown, the edgings of the feathers rather lighter and inclining to dull grayish olive; rectrices olive brown, deepening to sepia medially, and rather lighter, more

<sup>15</sup> Eleven specimens, from Puerto Rico, Culebra Island, and St. Thomas.

<sup>16</sup> Five specimens, from Puerto Rico and St. Thomas.

grayish, or olivaceous marginally; primaries and secondaries mummy brown, rather lighter on the external webs, which are narrowly margined with olivaceous; tertials dark brown, between clove brown and sepia, broadly edged with light grayish olive and dull grayish olive; primary coverts mummy brown; greater and median wing-coverts between mummy brown and Prout's brown, the inner ones more or less broadly margined with dull grayish olive, some of the greater coverts somewhat tinged with cinnamon brown, also a little spotted or irregularly barred with ochraceous buff or whitish; lesser wing-coverts Saccardo's umber; alula between mummy brown and Prout's brown, sparingly and faintly barred with dull ochraceous buff, the outer web of the outermost feather almost wholly of this color; sides of head rather light mouse gray, the lores, together with a rather narrow subocular stripe, buffy brown; a lengthened spot on lower eyelid and a supraloral streak light buff; sides of neck and middle of upper jugulum grayish olive, more or less mixed with pale ochraceous buff and light ochraceous buff; chin and upper throat dull creamy white, laterally pinkish buff; middle of lower throat pinkish buff, somewhat dulled by an admixture of pale gray; breast and lower part of jugulum between cinnamon buff and pinkish cinnamon, slightly dulled by a faint wash of whitish or pale grayish; abdomen dull white; sides and flanks between buffy brown and hair brown, rather narrowly barred with dull white; lower tail-coverts white, most of the feathers heavily barred with grayish clove brown; thighs exteriorly drab, faintly barred with pale dull buff, anteriorly dull grayish cream color; lining of wing anteriorly mostly cinnamon brown, posteriorly soon passing into dark hair brown, and everywhere narrowly barred with white.

Specimens from the following localities have been examined:

CULEBRA ISLAND, PUERTO RICO, WEST INDIES: Playa Sardine (April 12, 1912).

PUERTO RICO: La Playita, Salinas (May 2, 1912, April 29, 1912, April 30, 1912); Punta Picua, Mameyes (February 12, 1912); San Juan (January 4, 1899); La Playa, Manati (July 8, 1912).<sup>17</sup>

ST. THOMAS ISLAND, VIRGIN ISLANDS: (No definite locality) (1860).

**RALLUS LONGIROSTRIS VAFER Wetmore**

**HISPANIOLAN CLAPPER RAIL**

*Rallus longirostris vafér* WETMORE, Proc. Biol. Soc. Washington, vol. 41, p. 121, June 29, 1928 ("Étroite, Gonave Island, Haiti").

*Subspecific characters.*—Similar to *Rallus longirostris limnetis*, but wing and tarsus longer, tail and middle toe somewhat longer; upper parts in dark phase darker, averaging somewhat more olivaceous (less

<sup>17</sup> Type.

grayish); upper parts in light phase averaging lighter; both dark and light phases averaging darker on the lower parts.

*Measurements.*—Adult male<sup>18</sup>: Wing, 151–159.5 (average, 155) mm; tail, 61.5–66.4 (63.3); exposed culmen, 63.8–68.5 (65.5); tarsus, 57–61 (59); middle toe without claw, 50–54 (51.9). Adult female<sup>19</sup>: Wing, 134.5–144.5 (138.4); tail, 54.4–60 (56.9); exposed culmen, 53.6–63 (58.7); tarsus, 46.4–59.5 (52.8); middle toe without claw, 40.5–45 (43.6).

*Type locality.*—Étroite, Gonave Island, Haiti.

*Geographic distribution.*—Permanent resident in Haiti and Dominican Republic, with their coastal islands.

*Remarks.*—In this race there is nearly always more or less gray on the central portion of the jugulum. There are four well-defined color phases—light brown, dark brown, light gray, and gray-breasted dark brown.

The following specimens have been examined:

HAITI: Caracol (April 27, 1927); Étroite, Gonave Island (March 18, 1920,<sup>20</sup> and March 19 and 20, 1920); Pekim, Gonave Island (July 7 and 8, 1920); Petite Gonave (March 19, 1930); Fort Liberté (February 18, 1929); Petit Trou de Nippes (April 9, 1930); Grande Cayemite (April 11, 1930).

DOMINICAN REPUBLIC: Monte Cristi (February 18, 1916).

#### RALLUS LONGIROSTRIS CORRIUS Maynard

##### BAHAMA CLAPPER RAIL

*Rallus Corrius* MAYNARD, Amer. Exchange and Mart, vol. 3, no. 5, p. 33, col. 2, Jan. 15, 1887 ("an Island off the south shore of Andros [Island, Bahama Islands]").

*Rallus Coryi* MAYNARD, Amer. Exchange and Mart, vol. 3, no. 6, p. 69, col. 3, Feb. 5, 1887 ("an island off the south shore of Andros [Island, Bahama Islands]").

*Subspecific characters.*—Similar to *Rallus longirostris limnetis*, but bill, tarsus, and middle toe shorter; upper and lower parts very much paler.

*Description of soft parts.*—"Iris red brown; bill orange brown, except culmen and tip, which are blackish; legs and feet brownish orange" (W. W. Worthington).

*Measurements.*—Adult male<sup>21</sup>: Wing, 137–150 (average, 146) mm; tail, 53.5–67 (61.3); exposed culmen, 53–65 (59.5); tarsus, 45–53.5 (49.4); middle toe without claw, 44.5–49.8 (47.8). Adult female<sup>22</sup>:

<sup>18</sup> Four specimens, from Haiti; measurements, except for the middle toe, taken by Wetmore, *loc. cit.*

<sup>19</sup> Seven specimens, from Haiti and Dominican Republic; measurements, except for middle toe, taken by Wetmore, *loc. cit.*

<sup>20</sup> Type.

<sup>21</sup> Seven specimens, from the Bahama Islands.

<sup>22</sup> Ten specimens, from the Bahama Islands.

Wing, 128.5–141 (134.7); tail, 54–62 (57.5); exposed culmen, 52–60.5 (55.3); tarsus, 42–50 (46.9); middle toe without claw, 38.5–45 (43.2).

*Type locality*.—An island off the southern shore of Andros Island, Bahama Islands.

*Geographic distribution*.—Permanent resident in the central and northern Bahama Islands, north to Abaco Island and Berry Islands; west to Andros Island and the keys nearby; south to Ragged Island; and east to Watling Island, New Providence Island, and Eleuthera Island.

*Remarks*.—The Bahama clapper rail differs from *Rallus longirostris longirostris* in somewhat longer wing and bill, slenderer bill, and much paler coloration throughout. Birds from the various islands of the Bahama group, so far as our material goes, apparently exhibit no geographic differences. There are, furthermore, no well-marked color phases in this subspecies.

This rail was originally described by C. J. Maynard in a little-known publication, along with other new birds from the Bahama Islands. His original description called the bird *Rallus Corrius*,<sup>23</sup> but there is no evidence in this *original* place of description that the spelling of the specific name was a typographical error. At a later date, however, in the same journal Mr. Maynard republished this description and there called the bird *Rallus Coryi*,<sup>24</sup> evidently intending this name to replace *Rallus Corrius*, although he did not so state. Current rules of zoological nomenclature permit no change in the original spelling of technical specific names, aside from the change in termination necessary to make specific and subspecific names agree in gender with their generic names, and also cases in which a typographical error is obvious in the *original* publication. The word "Corrius" could easily have been formed as an adjective from Mr. Cory's name; so that under the circumstances it seems more logical to use this form rather than the emendation later proposed.

The writer has examined specimens from the following localities:

BAHAMA ISLANDS: Key south of Andros Island (April 29, 1884)<sup>25</sup>; South Andros Island (May 22, 1904, June 14, 1904); Southern Ragged Island (April 6, 1907); Berry Islands (April 7 and 8, 1891); Marsh Harbor, Abaco Island (July 6, 1904); Staniard Creek, Andros Island (April 15, 1909); New Providence Island (June 24, 1903); Watling Island (March 17, 18, 22, and 27, 1909; and August 17, 1923); Lake Isabella, Watling Island (March 23, 1909).

<sup>23</sup> Amer. Exchange and Mart, vol. 3, no. 3, p. 33, col. 2, Jan. 15, 1887.

<sup>24</sup> Amer. Exchange and Mart, vol. 3, no. 6, p. 69, col. 3, Feb. 5, 1887.

<sup>25</sup> Type.

## RALLUS LONGIROSTRIS CUBANUS Chapman

## CUBAN CLAPPER RAIL

*Rallus longirostris cubanus* CHAPMAN, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 288, Dec. 29, 1892 ("Casilda, coast of southern Cuba").

*Subspecific characters*.—Similar to *Rallus longirostris limnetis*, but wing longer; bill averaging somewhat shorter; tarsus and middle toe shorter; upper parts much darker and somewhat more brownish (less grayish); lower parts darker, particularly the breast, sides, and flanks, the last two usually with narrower white bars.

*Measurements*.—Adult male<sup>26</sup>: Wing, 142.5–159 (average, 149) mm; tail, 57–67 (61.8); exposed culmen, 58–66 (62.7); tarsus, 52.5–55.5 (54.9); middle toe without claw, 45–51.5 (48.2). Adult female<sup>27</sup>: Wing, 128–139.5 (132.6); tail, 49–65 (58.5); exposed culmen, 57–61 (59); tarsus, 48–54 (52); middle toe without claw, 43.5–45.5 (44.8).

*Type locality*.—Casilda, near Trinidad, on the southern coast of Cuba.

*Geographic distribution*.—Permanent resident of the island of Cuba.

*Remarks*.—The Cuban clapper rail differs from *Rallus longirostris manglecola* in shorter bill, in having the ground color of the upper surface somewhat darker, less rufescent (more grayish), the upper wing-coverts less uniform and darker, the cinnamon of breast paler and duller.

The present race and *Rallus longirostris corrius* represent two extremes in coloration, and the former is so very much darker, more brownish above, and so much darker below, particularly on the sides and flanks, and has such narrow white bars on the flanks that it is separable at a glance. There are three well-marked color phases in this subspecies, a light gray, a dark gray, and, though the middle of the jugulum is more or less grayish in practically all the specimens, also a gray-breasted phase, in which the cinnamon on the breast disappears and is replaced entirely by grayish, while all the rest of the under parts is more or less clearly grayish. Very pale specimens of the light-gray phase sometimes resemble specimens of other races.

The following specimens have been examined:

CUBA: Mariel (May 10, 1900); Boqueron (August 19, 1930); Manzanillo, Oriente (September 2 and 3, 1930); Casilda, near Trinidad (April 14, 1892)<sup>28</sup>; Preston (March 6 and 15, 1915, February 23 and 27, 1915); wharf on Los Canos Estate, Manati, Guantanamo (February 29, 1912); Guantanamo (July 3, 1908, August 10, 1909, April 4, 1910, October 3, 1910).

<sup>26</sup> Eight specimens, from Cuba.

<sup>27</sup> Four specimens, from Cuba.

<sup>28</sup> Type.

## RALLUS LONGIROSTRIS LEUCOPHAEUS Todd

## ISLE OF PINES CLAPPER RAIL

*Rallus longirostris leucophaeus* TODD, Proc. Biol. Soc. Washington, vol. 26, p. 174, Aug. 8, 1913 ("Majagua River, Isle of Pines").

*Subspecific characters.*—Similar to *Rallus longirostris cubanus*, but wing averaging somewhat shorter; upper parts more grayish (less brownish), and averaging somewhat lighter; jugulum, sides, flanks, and crissum more grayish (less rufescent), and the middle of the abdomen much paler cinnamon buff, barely tinged with this color, or white, and the white bars on flanks broader. b. 113

*Description.*—Type, adult male, Carnegie Museum no. 39717, Majagua River, Isle of Pines, November 7, 1912; G. A. Link, original number, 262.

Forehead, crown, and occiput fuscous, many of the feathers of the forehead and crown with stiff, shiny, black shafts; hind-neck between hair brown and deep mouse gray, becoming on posterior portion like the pileum, and a little, but narrowly and inconspicuously, streaked with light dull gray edgings of the feathers; feathers of the back medially clove brown, of the scapulars fuscous black, all margined, but more broadly on posterior portions, with light mouse gray; rump and upper tail-coverts clove brown, with very broad mouse-gray feather margins; rectrices medially fuscous black, the outer margins widely mouse gray verging to deep mouse gray, the inner margins clove brown; primaries and secondaries brown, between clove brown and bister, the inner margins paler, the outer edges bister; tertials like the scapulars; greater wing-coverts olive brown, with narrow more or less irregular whitish and buffy bars; median and lesser coverts between Saccardo's umber and sepia, basally rather more tawny, the inner ones somewhat grayish; alula between benzo brown and fuscous, the two long feathers irregularly barred with cream color and cream buff; lores and rictal region hair brown; supraloral streak dull cream buff; and elongated spot on lower eyelid dull white; remainder of the sides of head, together with the sides of neck, gray, between pale mouse gray and smoke gray; chin and throat white; middle of lower throat dull white, very slightly washed with buff; sides of jugulum gray like the sides of the neck but a little darker and slightly washed with buff; middle of jugulum dull pale ochraceous buff; breast and middle of abdomen grayish cream white washed laterally with pale ochraceous buff, and shading into the buff of jugulum on the anterior portion of the breast; flanks and sides of body somewhat light chaetura drab, rather narrowly barred with white; lower tail-coverts white, all but the longer lateral feathers broadly barred with the chaetura drab of the flanks, these dark bars much wider than the white interspaces; lining of wing anteriorly fuscous, posteriorly shading into the

brownish chaetura drab of the flanks, and narrowly barred throughout with dull white; thighs posteriorly cream color, anteriorly mouse gray.

*Measurements.*—Adult male <sup>29</sup>: Wing, 135–155 (average, 146) mm; tail, 57.5–67.5 (61.8); exposed culmen, 60.5–66 (63.3); tarsus, 50–59 (55.3); middle toe without claw, 44–49.5 (46.4). Adult female <sup>30</sup>: Wing, 127.5–149 (134.3); tail, 53–62.5 (58.6); exposed culmen, 51.5–59.5 (56.3); tarsus, 45–51.5 (49.3); middle toe without claw, 39–43.5 (41.2).

*Type locality.*—Majagua River, Isle of Pines, West Indies.

*Geographic distribution.*—Permanent resident on the Isle of Pines.

*Remarks.*—This clapper rail differs from *Rallus longirostris limnetis* of Puerto Rico in darker, more grayish upper surface; darker lower surface, the sides and flanks more slaty or grayish (less rufescent), the cinnamon of the anterior lower parts decidedly paler; middle of abdomen with much less wash of cinnamon buff, or entirely white; and the white bars on sides and flanks somewhat narrower. It is similar to *Rallus longirostris corrius* of the Bahama Islands but has a longer tarsus and is very much darker above, with the centers of the feathers more blackish, the anterior lower parts, together with the sides, flanks, and crissum, much darker, the flanks with narrower bars, the throat and breast of much darker cinnamon buff.

Individual variation in this race is great, as in most of the races of clapper rails, and consists chiefly in the darker shade of the head and hind-neck; darker, more blackish upper parts in some specimens; the rufescence of the wing in certain individuals; the extent of the white area on the throat, and of the median white area on the foreneck and abdomen. In some specimens the median white area on the foreneck is barely interrupted by the gray of the jugulum, though in most specimens this area is thus definitely interrupted. The cinnamon buff on the chest ranges from almost none to a rather deep suffusion; the width of the white bars on the flanks varies also; the lower tail-coverts are sometimes mostly white barred with black, and sometimes mostly black barred with white; and the depth of the gray on the jugulum is much darker in some specimens than in the type.

In normal phase this subspecies is moderately cinnamonaceous below and gray above, but there are two phases above, a gray and a brown, and below a light phase, a dark phase, and a gray-breasted phase. In the last-mentioned the lower parts except for the chin and middle throat, flanks, and sides, and crissum are brownish gray, deepest on the jugulum, breast, and sides of the breast, somewhat tinged with cinnamon buff on the middle of the breast, and much paler but not buffy on the middle of the abdomen. The upper parts in the brown phase are very much like those in the brown phase of *Rallus longirostris*

<sup>29</sup> Twelve specimens, from the Isle of Pines.

<sup>30</sup> Twelve specimens, from the Isle of Pines.



*saturatus*, but compared with the normal (gray) phase of the present race they are more blackish, owing to the darker, more extensive centers of the feathers, with the bend of the wing more rufescent and the upper parts more rufous or ochraceous, the lower parts more deeply and brightly cinnamonaceous; in fact, superficially the whole bird in brown phase looks very much like *Rallus elegans*. What might be considered the normal phase of this subspecies is moderately cinnamonaceous below and gray above.

Specimens from the following localities have been seen:

ISLE OF PINES, WEST INDIES: Los Indios (September 27 and 30, 1912, October 3, 9, and 29, 1912); Majagua River (November 7, 1912,<sup>31</sup> October 26, 1912); Nueva Gerona (March 12, 13, 14, 16, and 19, 1917).

**RALLUS LONGIROSTRIS CARIBAEUS Ridgway**

CARIBBEAN CLAPPER RAIL

[*Rallus longirostris*] c. var. *caribaeus* RIDGWAY, Bull. Nuttall Orn. Club, vol. 5, no. 3, p. 140, July 1880 ("West Indies").

*Subspecific characters*.—Similar to *Rallus longirostris cubanus* but lighter and more uniform both above and below, the centers of the feathers on the back and other posterior upper parts much less blackish, less sharply contrasted with edgings; white bars on flanks broader.

*Measurements*.—Adult male<sup>32</sup>: Wing, 148.5–150 (average, 149.2) mm; tail, 60–66.5 (63.2); exposed culmen, 58.5–62 (60.2); tarsus, 53–55 (54); middle toe without claw, 48–50 (49). Adult female<sup>33</sup>: Wing, 142.5; tail, 61.5; exposed culmen, 55; tarsus, 49; middle toe without claw, 44.

*Type locality*.—Spanish Town, Jamaica, West Indies.

*Geographic distribution*.—Permanent resident in Jamaica.

*Remarks*.—The present race differs from *Rallus longirostris manglecola* in shorter bill; in having the ground color of the upper parts, including the wings, of a lighter, more rufescent brown, the edgings also more brownish (less grayish); cheeks and sides of neck more rufescent (less grayish); and the anterior lower parts lighter, duller, less pinkish (more ochraceous) cinnamon.

It differs from *Rallus longirostris longirostris* in longer wing, darker upper parts, and somewhat narrower white bars on the flanks; from *Rallus longirostris corrius* in somewhat larger size, much darker upper and lower surfaces, and somewhat narrower white bars on the flanks; from *Rallus longirostris limnetis* in shorter bill, more rufescent (less grayish) upper surface, this including both the centers and margins of the feathers; duller, more ochraceous jugulum and breast, and more rufescent sides and flanks. From *Rallus longirostris leucophaeus* of the Isle of Pines it may be readily separated by its shorter bill, lighter,

<sup>31</sup> Type.

<sup>32</sup> Two specimens, from Jamaica.

<sup>33</sup> One specimen, from Jamaica.

more brownish (less grayish) upper surface, the feather centers there much less blackish and much lighter; less grayish (more brownish) lower surface, the anterior parts being duller and more uniform ochraceous buff.

In this race the jugulum is slightly but more or less evenly washed with grayish, making the color of this part rather dull. All the specimens that the writer has seen are in what might be taken for the brown phase, as there are no grayish birds among them.

Specimens from the subjoined localities have been examined:

JAMAICA: Near Spanish Town<sup>34</sup>; Great Salt Pond (January —, 1865).

**RALLUS LONGIROSTRIS PALLIDUS** Nelson

YUCATAN CLAPPER RAIL

*Rallus pallidus* NELSON, Proc. Biol. Soc. Washington, vol. 18, p. 141, June 9, 1905 ("Rio Lagartos, Yucatan, Mexico").

*Subspecific characters*.—Similar to *Rallus longirostris caribaeus*, but upper parts decidedly lighter; flanks darker; and the cinnamon of lower surface more pinkish (less ochraceous).

*Measurements*.—Adult female<sup>35</sup>: Wing, 143 mm; tail, 59.5; exposed culmen, 53; tarsus, 48; middle toe without claw, 48.

*Type locality*.—Rio Lagartos, northwestern Yucatan, Mexico.

*Geographic distribution*.—Permanent resident in northern Yucatan and eastern Quintana Roo, Mexico.

*Remarks*.—This clapper rail differs from *Rallus longirostris crepitans* in having the bill shorter, upper parts including wings, particularly the mesial stripes, and tail more rufescent (less grayish). It may be separated from *Rallus longirostris corrius* by the longer wing and middle toe, and darker breast, flanks, and upper parts. The only specimen known up to the present time is the type, but also the clapper rail recorded from eastern Quintana Roo by Griscom belongs probably to this race.

**RALLUS LONGIROSTRIS BELIZENSIS**, new subspecies

HONDURAS CLAPPER RAIL

*Subspecific characters*.—Similar to *Rallus longirostris pallidus*, but upper surface, including the crown, very much darker, the dark centers of the feathers blackish instead of olive brown, but the edgings of the feathers lighter, more purely gray.

*Description*.—Type, adult female, no. 19747, collection of E. A. and O. Bangs; Ycacos Lagoon, British Honduras, May 14, 1907; Morton E. Peck.

<sup>34</sup> Type

<sup>35</sup> One specimen, the type.

Pileum and hind-neck sepia brown, the latter somewhat streaked with narrow dull buff feather edgings; scapulars, interscapulars, and tertials with centers of clove brown and margins of clear medium gray, giving a conspicuously streaked appearance; rump and upper tail-coverts dark brown (between clove brown and sepia), broadly margined with dull olive gray; tail-feathers rather light bister brown, with central stripes of clove brown, broadest on the two middle pairs; primaries and secondaries sepia, the outer superior margins lighter; alula light bister brown, barred on exterior webs of feathers with cinnamon; upper wing-coverts exteriorly light bister brown, the greater and median series interiorly becoming grayish with clove brown shaft streaks, the greater coverts with a few narrow bars and speckles of whitish; sides of head olive gray, with a white supraloral stripe and small lengthened subocular spot; sides of throat dull buff; sides of jugulum wood brown, inconspicuously streaked with dull brown; chin and throat white; breast and center of jugulum light cinnamon, the middle of breast whitish; abdomen dull white; sides of body brownish gray, with broad shaft streaks of bister; flanks dark brownish gray, rather broadly barred with white; under tail-coverts white, broadly barred with dark brownish gray; thighs anteriorly dull white, posteriorly mouse gray; lining of wing dark brownish gray, narrowly barred with white.

*Measurements*.—Adult female<sup>36</sup>: Wing, 141.5 mm; tail, 57; exposed culmen, 57; tarsus, 48; middle toe without claw, 43.

*Type locality*.—Ycacos Lagoon, British Honduras.

*Geographic distribution*.—Permanent resident in eastern British Honduras.

*Remarks*.—This new race is similar to *Rallus longirostris corrius* of the Bahama Islands but decidedly darker on the upper parts, particularly the centers of the feathers on the mantle. It is similar to *Rallus longirostris caribaeus* but has the upper parts, including the crown, much darker, the dark centers of the feathers being mostly black instead of olive-brown.

The only specimen of this new race that the writer has seen is the type, but the characters exhibited by this specimen are such that it apparently warrants separation as a new race. It appears to be confined to the coast region of eastern British Honduras.

#### *RALLUS LONGIROSTRIS TENUIROSTRIS* Ridgway

##### MEXICAN CLAPPER RAIL

*Rallus elegans* var. *tenuirostris* RIDGWAY (Lawrence MS.), Amer. Nat., vol. 8, no. 2, p. 111, Feb. 1874 ("City of Mexico").

*Subspecific characters*.—Similar to *Rallus longirostris cubanus*, but tail and middle toe averaging somewhat longer; upper parts, particu-

<sup>36</sup> One specimen, the type

larly the edgings of the feathers, lighter, brighter, more rufescent (less grayish) (similar to the upper parts of *Rallus elegans*), cheeks more brownish, less clearly gray; bend of wing much more reddish, the cinnamon of the anterior lower parts darker, more pinkish, the jugulum without any indication of gray; sides and flanks lighter, the white bars averaging narrower and usually less distinct, often buff instead of white.

*Measurements*.—Adult male<sup>37</sup>: Wing, 151–159.5 (average, 156.5) mm; tail, 62–70.5 (66.5); exposed culmen, 62–65.5 (63.5); tarsus, 56–59 (57.8); middle toe without claw, 49–53 (51.1). Adult female<sup>38</sup>: Wing, 139–144.5 (142.4); tail, 59–65 (62.9); exposed culmen, 56–60 (58); tarsus, 47.5–53 (51.3); middle toe without claw, 44.5–48 (46.6).

*Type locality*.—Mexico City, Mexico.

*Geographic distribution*.—Permanent resident in the Mexican States of Mexico and Tlaxcala, chiefly in the Valley of Mexico.

*Remarks*.—This rail is similar to *Rallus longirostris caribaeus*, but its bill averages somewhat longer; the centers of the feathers on the upper parts are darker, more blackish, but the edgings lighter and brighter, thus much more strongly contrasted; bend of wing decidedly more reddish; cheeks more brownish, less clearly grayish; anterior lower parts darker, brighter, more pinkish cinnamon and less uniform; sides and flanks darker, the white bars narrower and less distinct.

This is one of the most distinct of all the races of *Rallus longirostris* and as previously stated is the form that most closely approaches *Rallus elegans* in its rather rufescent upper parts and reddish bend of the wing, but the olive colors of the upper parts are not so rufescent or ochraceous as in the latter species. Furthermore, it is one of the few clapper rails that are strictly fresh-water birds, confined as it is to the Valley of Mexico.

In this species the color phases are not so well marked as in some of the other races, although there are two phases involving the color of the upper parts, a gray phase and a brown phase. The jugulum is lacking entirely in the suffusion of gray; but birds in the juvenal plumage are very dark above with little cinnamon below, the body below nearly all white, more or less spotted laterally with brownish slate.

The available specimens represent localities as below:

MEXICO: Valley of Mexico.<sup>39</sup>

TLAXCALA: Lerma (July 2, 5, 6, 7, and 9, 1904).

<sup>37</sup> Four specimens, from the State of Tlaxcala, Mexico.

<sup>38</sup> Six specimens, from Tlaxcala, Mexico.

<sup>39</sup> Type

## RALLUS LONGIROSTRIS BELDINGI Ridgway

## BELDING CLAPPER RAIL

*Rallus beldingi* RIDGWAY, Proc. U. S. Nat. Mus., vol. 5, p. 345, [Sept. 11] 1882 ("Espiritu Santo Islands, Lower California").

*Subspecific characters*.—Similar to *Rallus longirostris tenuirostris*, but bill shorter, tarsus and middle toe somewhat so; upper surface darker and duller, the bend of the wing less reddish; lower parts much darker anteriorly (but without gray on jugulum); sides and flanks much darker, the bars more whitish and much more distinct; chin less extensively white; and center of breast not so often white.

*Description of soft parts*.—Basal two-thirds of mandible and posterior portion of maxillar tomium deep orange; remainder of bill dark dull brown; end of mandible paler; feet dark brown.

*Measurements*.—Adult male<sup>40</sup>: Wing, 147–160 (average, 155.1) mm; tail, 55–73 (64.8); exposed culmen, 53–63 (56.2); tarsus, 48–57 (53.1); middle toe without claw, 43–50 (47.8). Adult female<sup>41</sup>: Wing, 140–150 (144.8); tail, 54–68 (63.2); exposed culmen, 49–55.5 (52.7); tarsus, 45–53 (49.2); middle toe without claw, 40–47 (43.9).

*Type locality*.—Espiritu Santo Island, Lower California.

*Geographic distribution*.—Permanent resident in Lower California and its coastal islands, south to Cape San Lucas, and north to central Lower California; on the Pacific side to latitude 28° N. (Scammons Lagoon, Viscaïno Bay), and on the Gulf of California side to San Jose Island in latitude 25° N.

*Remarks*.—Among the specimens of this race examined there seems to be not nearly as much individual variation evident as in most of the other races of this species. Only one phase of plumage seems to be present.

Specimens have been examined from the localities listed below:

LOWER CALIFORNIA: La Paz (January 4, 183–, February 18, 1906, April 28, 1913, May 3, 7, 11, and 15, 1913); one mile west of La Paz (January 4, 1929, May 20 and 22, 1929, February 18, 1929); three miles southwest of La Paz (January 2 and 31, 1929; May 24 and 25, 1929); San Jorge (April 24, 26, 27, 28, and 30, 1931); San Jose Island (June 20, 1930); Santa Margarita Island (June 7 and 10, 1931); Espiritu Santo Island (February 1, 1882).<sup>42</sup>

## RALLUS LONGIROSTRIS LEVIPES Bangs

## LIGHT-FOOTED CLAPPER RAIL

*Rallus levipes* BANGS, Proc. New England Zool. Club, vol. 1, p. 45, June 5, 1899 ("Newport Landing, Los Angeles County, Calif.").

*Subspecific characters*.—Similar to *Rallus longirostris beldingi*, but wing, tarsus, and middle toe averaging somewhat longer; upper parts

<sup>40</sup> Fourteen specimens, from Lower California.

<sup>41</sup> Twelve specimens, from Lower California.

<sup>42</sup> Type.

lighter, the edgings more grayish (less rufescent) olive; lower surface anteriorly lighter, the chin more extensively white; sides and flanks averaging lighter, their white bars broader.

*Description of soft parts.*—Adult: "Iris dark brown; bill brownish orange at base, dusky along ridge and at tip; legs and feet dull orange brown, darkest at joints" (Grinnell, Bryant, and Storer). Nestling: "Bill dusky, with yellowish white band near end and yellow spot about nostril" (Grinnell, Bryant, and Storer).

*Measurements.*—Adult male <sup>43</sup>: Wing, 154.5–167 (average, 161.9) mm; tail, 62.5–69 (66.7); exposed culmen, 56–61 (58.9); tarsus, 53–60.5 (56.9); middle toe without claw, 50–54 (51.2). Adult female <sup>44</sup>: Wing, 138–155.5 (147.3); tail, 57–67 (62.6); exposed culmen, 51.5–58 (54.2); tarsus, 47–51 (49.5); middle toe without claw, 41–48 (44.9).

*Type locality.*—Newport Landing, Los Angeles County, Calif.

*Geographic distribution.*—Permanent resident on the coast of southwestern California, north to Santa Barbara, and south to northwestern Lower California (San Quintin Bay).

*Remarks.*—This form of the clapper rail resembles in a general way *Rallus longirostris tenuirostris*, but it differs in having a longer wing, shorter bill, lighter and brighter upper parts that are usually more rufescent olive, darker anterior lower parts, somewhat more deeply colored flanks and sides, and broader, more distinct, and more purely white bars on the flanks.

The jugulum in this race usually has no admixture or suffusion of gray, but occasionally has a slight wash of this color. The upper parts present two chief color phases, a brown, or rufescent olive, and a gray, both involving chiefly the edgings of the feathers. The lower parts, so far as known, have no gray-breasted phase.

Specimens have been examined from the following localities:

CALIFORNIA: Sunset Beach, Orange County (December 18, 1918, January 23, 24, and 31, 1917, February 27, 1917, February 7, 1918, February 23, 1921); Santa Barbara (July 1, 1875); Wilmington, Los Angeles County (November 16, 1879); San Diego County (May 9, 1905 [nestling], October 20, 1906); False Bay (April 10, 1908); National City (December 4, 1886, October 19, 1917); Newport Landing (February 23, 1886); Pacific Beach, San Diego County (September 13, 1904, November 25 and 29, 1905); Bolsa Chica Club, Orange County (January 31, 1900); San Diego (May 9, 1905).

LOWER CALIFORNIA: San Quintin Bay (December 8, 1930); mouth of Tia Juana River (July 17, 1894).

<sup>43</sup> Ten specimens, from California and northern Lower California.

<sup>44</sup> Twelve specimens, from California and Lower California.

## RALLUS LONGIROSTRIS OBSOLETUS Ridgway

## CALIFORNIA CLAPPER RAIL

*Rallus elegans* var. *obsoletus* RIDGWAY, Amer. Nat., vol. 8, no. 2, p. 111, Feb. 1874 ("San Francisco, Cal.").

*Subspecific characters.*—Similar to *Rallus longirostris levipes*, but tail longer; upper parts practically identical, but the cinnamon of the anterior lower parts decidedly paler and much less pinkish (more ochraceous), usually with a slight gray wash on the jugulum; sides and flanks averaging paler, the white bars on these parts slightly narrower.

*Description.*—Adult: "Iris dark brown or orange brown; bill reddish orange at base of lower mandible and along edge of upper, otherwise dusky olive brown; legs and feet dull orange brown, darkest at joints" (Grinnell, Bryant, and Storer). Nestling: Upper parts uniform glossy black with a greenish sheen; lower parts of body duller or more grayish black; basal half of bill blackish, terminal half whitish.

*Measurements.*—Adult male <sup>45</sup>: Wing, 153.5–170 (average, 161.7) mm; tail, 68–80 (73.1); exposed culmen, 55–66 (60.3); tarsus, 52–61 (56.7); middle toe without claw, 47–56 (51.3). Adult female <sup>46</sup>: Wing, 147–161 (151.6); tail, 60–76 (65.3); exposed culmen, 49–61 (55); tarsus, 45–63 (51.1); middle toe without claw, 44–51.5 (47.4).

*Type locality.*—San Francisco, Calif.

*Geographic distribution.*—Permanent resident in the coast region of central California; north to north-central California (Humboldt Bay), and south to south central California (Monterey Bay); accidental on South Farallon Island.

*Remarks.*—This is a very good subspecies, but it intergrades individually with *Rallus longirostris saturatus*. There are two color phases involving the upper surface, but no gray-breasted phase. In the brown phase the edgings of the upper parts are olivaceous, the centers of the feathers olive-brown. The gray phase differs from the brown phase in having much more grayish edgings on the feathers of the upper surface, particularly on the lower cervix, back, scapulars, and tertials, and also the dark centers of the feathers more blackish (less brownish). Specimens examined came from the localities here listed:

CALIFORNIA: Alameda County (January 9 and 29, 1932, October 4 and 9, 1932); Palo Alto (March 29, 1901, October 20, 1907, January 19, 1908, October 1, 1909, October 1, 1916, August 4, 1899, September 16, 1899); Alviso (November —, 1895, December 16, 1896); one-half mile north of Alviso (December 29, 1934); one mile north of Alviso (December 31, 1934); Point San Mateo (November 10, 1933); salt marshes, Marin County (October 30, 1877); San Francisco Bay

<sup>45</sup> Twenty-nine specimens, from California.

<sup>46</sup> Twenty-four specimens, from California.

(October 26, 1931); Bay Farm Island, Alameda County (April 3, 1915, October 3, 1925); Berkeley (November 27, 1891); Oakland (November 23, 1889); Redwood, San Mateo County (February 1, 1908, October 18, 20, 22, 23, 26, 28, 29, and 30, 1909); San Francisco (April —, 1877, March —, 1857<sup>47</sup>); Alameda (October 6, 1897).

**RALLUS LONGIROSTRIS YUMANENSIS** Dickey

**YUMA CLAPPER RAIL**

*Rallus yumanensis* DICKEY, The Auk, vol. 40, no. 1, p. 90, Jan. 10, 1923 ("Bard Imperial County, California").

*Subspecific characters.*—Similar to *Rallus longirostris obsoletus*, but wing and bill somewhat shorter; upper surface more grayish, that is, the edgings of the lower cervix, back, and scapulars are usually (in normal phase) more grayish (less brownish or olivaceous); cheeks somewhat more clearly gray (less brownish); cinnamon of anterior lower parts brighter, more pinkish, usually somewhat lighter; abdomen dull white instead of buff.

*Description.*—Type, adult male, no. J-1039, collection of D. R. Dickey; Bard, Imperial County, Calif., May 15, 1921; Mrs. May Canfield. Forehead and crown between buffy brown and olive brown, the feathers with stiff, shiny, blackish-brown shafts; occiput and upper cervix grayish olive brown; middle cervix similar but lighter and with narrow light dull wood-brown edgings; lower cervix fuscous on the broad central stripes of the feathers, and between light grayish olive and drab on the broad margins; feathers of back and scapulars dark fuscous centrally, dull light grayish olive marginally, in places more brownish; rump and upper tail-coverts between deep grayish olive and hair brown, with shaft stripes of fuscous; tail fuscous, the feathers margined with the color of the rump, most broadly on the middle pair; primaries, primary coverts, and secondaries, fuscous; tertials and the innermost secondary like the scapulars, but the latter more brownish marginally; exposed surface of greater wing-coverts between buffy brown and Saccardo's umber, rather darker outwardly; inner median and inner lesser coverts between buffy brown and citrine drab; outer median and outer lesser coverts between snuff brown and Saccardo's umber; sides of head dull mouse gray, the lores darker and more brownish, the lower eyelid dull creamy white; supraloral stripe buffy white, flecked with rusty; malar stripe dull light pinkish cinnamon, fading to almost white anteriorly; sides of neck like the middle portion of cervix, but paler and more or less suffused with light pinkish cinnamon; chin and throat, white; jugulum and breast, avellaneous with a cinnamon tinge, paling to light avellaneous on the middle of breast; abdomen dull creamy white; sides, flanks, and crissum, deep grayish hair brown, the flanks lighter, all barred with white, the outermost

<sup>47</sup> Type



feathers of crissum being nearly all white on their outer webs, the white bars on the sides about 1 mm wide, their brown interspaces about 8 mm; thighs between drab and hair brown posteriorly, dull cream white anteriorly; lining of wing grayish hair brown with very narrow widely spaced bars of dull white.

*Measurements*.—Adult male<sup>48</sup>: Wing, 156 mm; tail, 71; exposed culmen, 58; tarsus, 51.5; middle toe without claw, 46. Adult female<sup>49</sup>: Wing, 142–148 (average, 145); tail, 62–63 (62.5) exposed culmen, 53.5; tarsus, 50; middle toe without claw, 44–45 (44.5).

*Type locality*.—Bard, Imperial County, Calif.

*Geographic distribution*.—Permanent resident in southeastern California, from the Colorado River above Yuma, north to the Laguna Dam, and west to Salton Sea.

*Remarks*.—In this race the jugulum is entirely without grayish tinge. In the three specimens examined there is no indication of any definite color phase, though a male taken on May 15, 1921, at Bard, Imperial County, Calif., is much lighter on the anterior lower parts and slightly paler on the flanks than the female taken on May 5, 1921, but it is otherwise the same. Perhaps a larger series would show the existence of definite color phases. The bird inhabits apparently only the fresh-water marshes and canals adjoining the lower Colorado River and Salton Sea. It has never been taken elsewhere. It undoubtedly is one of the rarest of the rails of this group, and on account of its limited distribution and the circumstances under which it must exist it is possibly already extinct.

The following specimens have been examined:

CALIFORNIA: Bard, Imperial County (May 15, 1921,<sup>50</sup> May 27, 1921).

#### *RALLUS LONGIROSTRIS RHIZOPHORAE* Dickey

##### SONORA CLAPPER RAIL

*Rallus obsoletus rhizophorae* DICKEY, Trans. San Diego Soc. Nat. Hist., vol. 6, no. 18, p. 235, Dec. 24, 1930 ("Tobari Bay, southern Sonora, Mexico").

*Subspecific characters*.—Similar to *Rallus longirostris yumanensis*, but upper parts darker, more grayish (less brownish); anterior lower parts somewhat paler and duller; sides and flanks more grayish and somewhat darker.

*Measurements*.—Adult male<sup>51</sup>: Wing, 147–155.5 (average, 151.8) mm; tail, 60.5–65 (63.3); exposed culmen, 56–60.5 (59); tarsus, 54.5–58.5 (56.4); middle toe without claw, 45.5–51.5 (48.3). Adult female<sup>52</sup>: Wing, 139.5–148 (142.6); tail, 58–65 (61.6); exposed culmen, 53–57.5 (55.2); tarsus, 49–56 (50.9); middle toe without claw, 42–47 (43.8).

<sup>48</sup> One specimen (the type), from southeastern California.

<sup>49</sup> Two specimens, from southeastern California.

<sup>50</sup> Type.

<sup>51</sup> Five specimens, from Sonora, Mexico, including the type.

<sup>52</sup> Nine specimens, from Sonora, Mexico.

*Type locality*.—Tobari Bay, southern Sonora, Mexico.

*Geographic distribution*.—Permanent resident in the coast region of central and southern Sonora, from Guaymas to the boundary of Sinaloa.

*Remarks*.—The jugulum in this subspecies is entirely without gray, being uniform cinnamon like the breast. Color phases are not so marked in this race, although there are two that are well defined, a brown and a gray, involving only the upper parts.

The following specimens have been examined:

SONORA: Tobari Bay (April 28, 1930,<sup>53</sup> April 30, 1930, May 1, 1930); Guaymas (May 5, 1930); Viejo Yaqui Lagoon (May 12, 1930).

**RALLUS LONGIROSTRIS NAYARITENSIS McLellan**

**SAN BLAS CLAPPER RAIL**

*Rallus nayaritensis* McLellan, Proc. California Acad. Sci., ser. 4, vol. 16, no. 1, p. 9, Jan. 31, 1927 ("San Blas, Nayarit, Mexico").

*Subspecific characters*.—Similar to *Rallus longirostris rhizophorae*, but wing and tail shorter; upper parts darker, less grayish (more olivaceous); cinnamon on jugulum duller but yet without a gray wash.

*Description*.—Type, sex unknown, California Academy of Sciences no. 28184; San Blas, Nayarit, Mexico, October 19, 1925; Miss M. E. McLellan; original number, 483. Pileum fuscous, verging toward hair brown on the forehead, the feathers with stiff, shiny, blackish-brown shafts; cervix dark hair brown with narrow lighter edgings between drab and grayish olive, these edgings imparting a streaked appearance; back, upper tail-coverts, and tail, fuscous black, the feathers all edged with lighter, on the back with light grayish olive, on the upper tail-coverts with rather brownish deep grayish olive, and on the tail with a darker shade of the same; wings fuscous, the lesser wing-coverts with the outer portion of outer median and greater coverts more or less extensively rufescent brown, between snuff brown and Saccardo's umber, the inner coverts, tertials, and scapulars, broadly margined with dull grayish olive; sides of head mouse gray, rather darker on the lores, the auriculars washed with buff; supraloral streak creamy white; sides of neck mouse gray washed with buffy; chin and upper throat, white; malar stripe and jugulum between avellaneous and pinkish cinnamon; breast deep vinaceous cinnamon, posteriorly paling to light pinkish cinnamon; sides and flanks between hair brown and chaetura drab, narrowly barred with dull white, and posterior portion of flanks paler and washed with buff; abdomen creamy white, laterally washed with light pinkish cinnamon; lower tail-coverts between hair brown and chaetura drab, narrowly barred with white, anteriorly somewhat washed with buff, but the lateral

<sup>53</sup> Type.

feathers almost wholly white; thighs anteriorly buffy white, posteriorly dull hair brown; lining of wing between chaetura drab and fuscous, narrowly barred with dull white.

*Measurements*.—Nearly adult <sup>54</sup>: Wing, 129 mm (in molt); tail, 56.5; exposed culmen, 59; tarsus, 50.5; middle toe without claw, 49.

*Type locality*.—San Blas, Nayarit, Mexico.

*Geographic distribution*.—Permanent resident on the coast of Nayarit (Tepic), north to central Sinaloa (Mazatlan).

*Remarks*.—Notwithstanding the fact that the description and characters of this race depend upon the single specimen, which is not quite adult, apparently in the fresh first autumn plumage, it nevertheless seems to be subspecifically separable from all the known forms of the species. It is very different from *Rallus longirostris yumanensis*, having the wing and tail shorter; the bill somewhat longer; upper parts very much darker and more grayish, the centers of the feathers more extensively blackish, their edgings more purely grayish; the white bars on flanks and crissum narrower; the remainder of the lower posterior parts more whitish medially, the cinnamon on the lower parts not so extensive, though this difference may be due in part to slight immaturity.

It is similar to *Rallus longirostris obsoletus*, but the wing, tail, and tarsus are shorter; the upper parts darker, more grayish (less brownish or olivaceous), the centers of the feathers more blackish; the anterior lower parts less extensively cinnamon and much brighter; the middle of the abdomen more nearly white; and the white bars on the flanks narrower.

#### **RALLUS LONGIROSTRIS SATURATUS** Ridgway

##### LOUISIANA CLAPPER RAIL

[*Rallus longirostris*] *d. var. saturatus* RIDGWAY (Henshaw MS.), Bull. Nuttall Orn. Club, vol. 5, no. 3, p. 140, July 1880 ("Louisiana").

*Subspecific characters*.—Similar to *Rallus longirostris nayaritensis*, but wing and tail longer; upper parts rather lighter, the edgings less purely grayish, the central portions of the feathers narrower; cinnamon of breast rather darker and duller; posterior lower parts less whitish on median portion; flanks and crissum with much broader white bars.

*Description of soft parts*.—Iris orange; inside of mouth yellow; culmen dull brown; gonys flesh color; sides of bill reddish yellow; legs pale plumbeous.

*Measurements*.—Adult male <sup>55</sup>: Wing, 140.5–163 (average, 150.4) mm; tail, 58–68 (63.6); exposed culmen, 54–69 (61.7); tarsus, 47–55 (50.9); middle toe without claw, 43–52.5 (47.6). Adult female <sup>56</sup>:

<sup>54</sup> One specimen (the type), from San Blas, Nayarit, Mexico.

<sup>55</sup> Twenty-three specimens, from Texas and Louisiana.

<sup>56</sup> Sixteen specimens, from Texas, Louisiana, and Mississippi.

Wing, 131–154 (141.3); tail, 56–66 (60.9); exposed culmen, 55.5–64 (59.9); tarsus, 42–52.5 (47.7); middle toe without claw, 38–47 (43.9).

*Type locality*.—The Rigolets Lighthouse between Lake Borgne and Lake Ponchartrain, southeastern Louisiana.

*Geographic distribution*.—Permanent resident in the region of the coast of the Gulf of Mexico, east to southwestern Alabama (Perdido Bay), and west from southern Mississippi and southern Louisiana to central southern Texas (Brownsville). Casual southeastward to central western Florida (Seven Oaks on Tampa Bay).

*Remarks*.—This clapper rail differs from *Rallus longirostris yumanensis* in shorter tail and longer bill and in having the cinnamon of the anterior lower parts duller and less pinkish, the abdomen less purely white (somewhat more buffy), and the white bars on sides and flanks averaging wider. From *Rallus longirostris obsoletus* of California, which (in normal phase) it rather closely resembles, it may be distinguished by its shorter wing, tail, tarsus, and middle toe; rather broader dark centers of the feathers on the upper surface; lighter pileum, somewhat less trenchantly defined from the cervix; less deeply cinnamomeous anterior lower surface; rather darker flanks, the white bars averaging broader; lighter, less brownish, more grayish sides of head; less blackish lores; and broader, more distinct superciliary stripe. From *Rallus longirostris cubanus* it may be separated by its lighter upper and lower surface and broader white bars on the flanks; from *Rallus longirostris caribaeus* by the darker, more blackish feather centers of the upper parts, the darker cinnamon of the lower surface, and the darker flanks; and from *Rallus longirostris limnetis* on account of its longer wing and tail, somewhat shorter tarsus and middle toe; rather darker upper parts; darker cinnamon of the breast; rather broader white bars on flanks; and (in normal phase) jugulum less tinged with grayish.

In this race the jugulum is usually more or less gray, although there are specimens which lack practically all tinge of this color. Throughout the range of this race as assigned there seems to be no geographic variation, since birds of southern Texas appear to be identical with those from Alabama. Individual variation is highly developed in this subspecies. The great range of difference involves not only color but size. The throat is sometimes almost pure white, varying from this to cinnamon buff; the breast and jugulum range from very pale to deep cinnamon, almost as dark as in *Rallus elegans*. The flanks are in some specimens light hair brown, in others decidedly blackish; the top of the head ranges from blackish brown to rather light rufescent brown; the centers of the feathers on the back and scapulars vary from blackish clove brown to rather light rufescent brown; the edgings of the back and scapulars from nearly pure gray to olive gray and brownish olive gray. The white bars on the flanks

range in width from 1.8 to 3.5 mm, averaging about 2.5 mm. There are at least five well-defined color phases—light brown, dark brown, light gray, dark gray, and gray-breasted.<sup>57</sup>

The following specimens have been examined by the writer:

ALABAMA: Dauphin Island (May 19, 1911, August 16 and 17, 1911); Perdido Bay (September 2 and 15, 1911); Grande Batture Island (May 23, 1911; September 5, 1911, July 21, 1911); Bayou Labatre (May 22, 1911, August 5 and 11, 1911); Petit Bois Island (August 30, 1911, June 3, 1914).

FLORIDA: Seven Oaks (March 9, 1910).

LOUISIANA: Octave Pass, Mississippi River Delta (January 31, 1911, February 2, 3, and 4, 1911); Main Pass, Mississippi River Delta (January 31, 1910); Timbalier Island (May 25, 1895); Petite Anse Island (May 2, 1894); Raccoon Pass (May 19, 1895, May 20, 1897); Isle Derniere (May 21, 1894).

MISSISSIPPI: Biloxi (May 26, 1911); Bay St. Louis (September 23, 1898, April 19, 1902); Horn Island (July 3, 1913).

TEXAS: Padre Island (May 10 and 28, 1915; September 2, 5, and 6, 1914); Houston (June 14, 1922); Rockport (August 8, 1893; October 2, 1893); Corpus Christi; Peat Island, Laguna Madre (April 15, 1889); Galveston (February 28, 1877); Sabine (August 30, 1902); Tarpon (July 21, 22, 23, 24, 25, 26, 27, and 28, 1910; October 6, 9, 11, 12, 14, 16, and 17, 1910); Brownsville (July 19, 1891 [nestling]).

#### **RALLUS LONGIROSTRIS SCOTTII Sennett**

##### **FLORIDA CLAPPER RAIL**

*Rallus longirostris scottii* SENNETT, The Auk, vol. 5, no. 3, p. 305, July 1888 ("Tarpon Springs, Florida").

*Subspecific characters.*—Similar to *Rallus longirostris saturatus*, but wing and tail somewhat shorter; upper parts much more deeply colored, the dark centers of the feathers more blackish, less olive brownish; breast and flanks darker, the white bars on the latter narrower; lower parts much more extensively grayish.

*Measurements.*—Adult male<sup>58</sup>: Wing, 135–155 (average, 146) mm; tail, 56.5–72 (63.3); exposed culmen, 56–66 (61.6); tarsus, 42–55.5 (49.8); middle toe without claw, 39.5–49 (45.5). Adult female<sup>59</sup>: Wing, 128.5–145 (137); tail, 54.5–63.5 (59.2); exposed culmen, 51.5–60 (55.9); tarsus, 42–51 (45.6); middle toe without claw, 37–45 (41.9).

*Type locality.*—Tarpon Springs, Fla.

<sup>57</sup> For detailed description of the differences between these color phases, see the introductory paragraphs, *antea*, pp. 318–319.

<sup>58</sup> Twenty-three specimens, from Florida.

<sup>59</sup> Eighteen specimens, from Florida and Alabama.

*Geographic distribution.*—Permanent resident in Florida; north on the southeastern coast to Jupiter, on the western coast north to northwestern Florida (Pensacola); and south to extreme southern Florida (Cape Sable). Casual northwest to southwestern Alabama (Perdido Bay).

*Remarks.*—The upper parts in certain specimens are very similar to those of *Rallus longirostris nayaritensis*, but on the average they are darker than in that form. The lower parts likewise are darker and duller, excepting the flanks. Compared with *Rallus longirostris cubanus* the present race has a somewhat shorter wing and shorter tarsus and middle toe; darker upper parts; slightly darker flanks, with slightly wider white bars; and in the gray-breasted phase the whole lower surface gray, either without cinnamonaceous or nearly so.

In *Rallus longirostris scottii* there is much variation in the width of the white bars on the flanks; and the jugulum is nearly always more or less gray. There are four well-defined color phases; i. e. (1) (normal), brown above with gray below; (2) brown above with cinnamon below; (3) gray above with gray below; (4) and gray above with cinnamon below. The gray phases are well marked by the much more grayish (less ochraceous or brownish) edges of the feathers on the upper parts. There is a pronounced gray phase of the lower parts in which much of the cinnamon and the posterior whitish of abdomen are replaced by dark gray, making the whole under surface appear much darker, since what cinnamon there is left is much duller. As already mentioned this gray phase of the lower parts occurs in combination with the gray and brown phases of the upper surface.

A single specimen from the mouth of Perdido Bay in southwestern Alabama, taken on January 27, 1912, is, on the lower surface, a typical example of the present race, and is very dark above, although in this it is not extreme, and apparently verges a little toward *Rallus longirostris saturatus*. It is, however, doubtless a wanderer from eastward, for the breeding bird from Perdido Bay is practically typical *Rallus longirostris saturatus*. Three specimens from the eastern coast of Florida, a male taken 10 miles northwest of Palm Beach on May 28, 1920; one from Jupiter, March 6, 1920; and another from the same locality, March 20, 1921, are rather surprisingly absolutely indistinguishable from *Rallus longirostris scottii*, as comparison with an extensive series shows. Since these birds were taken so late in the season they evidently represent the breeding form of that part of the Florida coast, and indicate that the present race occupies the southern part of the peninsula on both coasts.

The following specimens have been examined by the writer:

ALABAMA: Mouth of Perdido Bay (January 27, 1912).

FLORIDA: Pensacola (July 28, 1926); Westbay (April 27 and 28, 1926); Horseshoe Point (May 25, 1926); Tarpon Springs (April 17,

1891, May 24, 1918, <sup>60</sup> December —, 1886, January 8, 1887, December 27, 1887, January 16 and 23, 1892, March 20, 1892, December 5 and 20, 1889, November 23, 1889, May 3, 1890, February 17 and 28, 1888); Tampa Bay (September 8, 1899, April 30, 1880); Fort Myers (January 16, 1892); Hernando County (December 1, 1880); Suwannee River, Lafayette County; mouth of Suwannee River (March 27 and 30, 1890); Charlotte Harbor; Clearwater; Port Richey (May 26, 27, and 28, 1918); 4 miles southwest of Punta Gorda (June 26, 1918); Anclote Keys (June 5, 1918); mouth of Chassahowitzka River (May 30 and 31, 1918); 10 miles northwest of Palm Beach (May 28, 1920); Jupiter (March 6, 1920, March 20, 1921); Goose Creek (March 13 and 16, 1920); East Goose Creek (November 22, 1917); St. Marks (May 18, 1926, nestling and adult; January 3 and 12, 1920); Seven Oaks (March 9, 12, and 15, 1910, June 1, 1899, October 21, 1903); Lukens (January 1, 1906); Anclote (April 15 and 27, 1899; March 1 and 8, 1897; February 27, 1897).

**RALLUS LONGIROSTRIS INSULARUM W. S. Brooks**

**MANGROVE CLAPPER RAIL**

*Rallus longirostris insularum* W. S. Brooks, Proc. New England Zool. Club, vol. 7, p. 53, June 24, 1920 ("Big Pine Key, Florida").

*Rallus longirostris helius* OBERHOLSER, Proc. Biol. Soc. Washington, vol. 33, p. 33, July 24, 1920 ("Sixth Key in the Newfound Harbor Group, southwest of Big Pine Key, Florida").

*Subspecific characters*.—Similar to *Rallus longirostris scottii*, but tail somewhat shorter; upper parts lighter, the edgings of the feathers much paler, and much more clearly grayish, less olivaceous; lower surface much lighter, less grayish; white bars on the flanks broader.

*Description*.—Type of *helius*, adult male, U.S.N.M. no. 255254; Sixth Key in the Newfound Harbor Group, southwest of Big Pine Key, Fla., May 12, 1919; Paul Bartsch. Pileum olive brown, the centers of the feathers darker; hind-neck between Saccardo's umber and sepia, mixed with grayish feather edgings, which posteriorly impart a streaked appearance; back and scapulars with the feathers centrally sepia, marginally clear gray; rump and upper tail-coverts sepia, with broad, dull, olive-gray feather margins; tail between olive brown and fuscous, the shafts of the rectrices clove brown; wings dark olive brown, the outer and inner edges of the quills lighter, the superior coverts still lighter and inclining to cinnamon, the inner coverts washed with grayish; outer web of outermost feather of alula mottled and partly edged with pale cinnamon; sides of head rather dark neutral gray, the lores darker and more brownish, the supraloral stripe and line on the lower eyelid dull white; sides of neck light neutral gray washed with buffy, posteriorly darker, less purely gray, and indistinctly streaked with dull brown; chin and throat white;

<sup>60</sup> Type.

malar stripe pale ochraceous buff; center of jugulum and whole of breast, between pinkish buff and pinkish cinnamon, the middle of breast paler; abdomen dull buffy white; sides of body and flanks rather dark brownish gray, broadly barred with white; lower tail-coverts white, widely barred with dark brownish gray; lining of wing rather dark hair brown, outwardly washed with rusty, and narrowly barred with white; thighs anteriorly dull white, posteriorly mouse gray.

*Measurements*.—Adult male<sup>61</sup>: Wing, 140–151.5 (average, 146) mm; tail, 51–64 (58.6); exposed culmen, 59–62.5 (61.2); tarsus, 47–54 (50.8); middle toe without claw, 45–49 (46.1). Adult female<sup>62</sup>: Wing, 129.5–136.5 (133.8); tail, 57–60 (58); exposed culmen, 53–59 (55); tarsus, 44–47 (45.1); middle toe without claw, 39–42 (40.5).

*Type locality*.—Big Pine Key, Fla.

*Geographic distribution*.—Permanent resident on the keys of southern Florida; northeast to Key Largo, southwest to Raccoon Key and Key West.

*Remarks*.—This very interesting and remarkably distinct race of the clapper rail seems to be confined to the Florida Keys. The jugulum is usually more or less gray, but sometimes the median portion is clear cinnamomeous. There are, as in most of the clapper rails, two color phases, involving, however, only the lower parts—one a dark phase, which is brownish gray anteriorly, the other a light phase, which is clear gray anteriorly or even without gray on the jugulum. The upper parts in both phases are alike.

The following specimens have been examined by the writer:

FLORIDA: Key West (August 12, 1893, December 24, 1888); Key Largo (March 11, 1930); Big Pine Key (April —, 1930); Sixth Key in the Newfound Harbor Group (May 12, 1919<sup>63</sup>); Raccoon Key (June —, 1889); Torch Key (March 25, 1930).

#### **RALLUS LONGIROSTRIS WAYNEI** Brewster

##### **WAYNE CLAPPER RAIL**

*Rallus crepitans waynei* BREWSTER, Proc. New England Zool. Club, vol. 1, p. 50, June 9, 1899 ("St. Mary's, Camden County, Georgia").

*Subspecific characters*.—Similar to *Rallus longirostris insularum*, but tail longer; gray edgings of the upper parts much darker and usually less purely gray; bend of wing and flanks darker.

*Measurements*.—Adult male<sup>64</sup>: Wing, 135–152 (average, 145.1) mm; tail, 57.5–72 (61.9); exposed culmen, 54–67.5 (62.2); tarsus, 46.5–53.5 (48.2); middle toe without claw, 40–48 (45.4). Adult

<sup>61</sup> Five specimens, from the Florida Keys, including the type of *Rallus longirostris helius*.

<sup>62</sup> Four specimens, from the Florida Keys.

<sup>63</sup> Type of *Rallus longirostris helius*.

<sup>64</sup> Fifteen specimens, from South Carolina, Georgia, and Florida, including the type.



female<sup>65</sup>: Wing, 129.5–146.5 (138.4); tail, 56–63.5 (59.9); exposed culmen, 53–62.5 (58.7); tarsus, 43.5–50 (46.7); middle toe without claw, 41.5–47.5 (44.4).

*Type locality*.—St. Marys, Camden County, Ga.

*Geographic distribution*.—Atlantic coast region of southeastern United States. Breeds north to central eastern South Carolina (Santee River); and south to southeastern Georgia and northeastern Florida (Merritt Island). Winters north to central eastern South Carolina (Charleston) and south to southeastern Florida (Jupiter).

*Remarks*.—From *Rallus longirostris saturatus* this race differs in smaller wing, tarsus, and middle toe; in more grayish edgings of the feathers on the upper parts; and usually more grayish anterior lower surface; while from *Rallus longirostris limnetis* of Puerto Rico it may be separated by its shorter tarsus and middle toe; somewhat darker upper surface, with more blackish centers of the feathers and more purely gray (less brownish) edgings; as well as by its more grayish (less brownish) flanks. From *Rallus longirostris leucophaeus* of the Isle of Pines it is distinguished by shorter tarsus; rather lighter, less blackish, centers of the feathers of the upper parts, giving this area a lighter tone; somewhat lighter flanks and sides, with wider white bars; and darker remaining lower parts. It is similar to *Rallus longirostris belizensis*, which is of about the same size, but the edgings of the upper parts are deeper, more olive gray, and the breast is darker.

There seems to be no geographic difference in *Rallus longirostris waynei*, but the individual variation is great. The throat ranges from pure white to strongly tinged with buff; the breast from dark cinnamon without grayish tinge to pale cinnamon, with or without much gray admixture, or to entirely gray; the middle of the abdomen ranges from pure white or pale buff to white with a grayish cinnamon tinge; the flanks vary from gray to hair brown, sometimes dark, in other individuals light; the lower tail-coverts are sometimes much marked with dark brown, but in other individuals very little so. The bars on the flanks vary in width from 1.2 to 3.2 mm, averaging about 2.5 mm. There are in this race five well-marked color phases, four of them involving the upper parts only—a light gray, a dark gray, a light brown, and a dark brown phase, to which should be added a gray-breasted phase. This race is one of the two partially migratory forms of *Rallus longirostris*, and although it is found in the winter practically throughout its breeding range, locally in reduced numbers, it wanders to a considerable distance south of its summer home.

The following specimens have been examined by the writer in this connection:

<sup>65</sup> Sixteen specimens, from South Carolina, Georgia, and Florida.

FLORIDA: Amelia Island (December 15, 17, 25, and 29, 1906; April 10, 1906, September 6, 1906, August 29, 1906, October 2, 16, 17, 18, 20, and 30, 1906, December 22, 28, and 29, 1905, January 11 and 25, 1906, November 27, 1905, February 8 and 9, 1906, May 9, 1906, June 26 and 27, 1906, October 17, 1901); northern Brevard County (April 4, 1905); Matanzas River (May 26, 1925); Anastasia Island (May 27, 1925); New Smyrna (May 23, 1925); Fort George, Duval County (January 21, 1917); Pilot Town; northern shore of Dimmits Creek, Indian River; Smyrna; Pallesier Creek (May 20 and 26, 1896).

GEORGIA: St. Marys, Camden County (March 18, 1878,<sup>66</sup> March 7, 15, 19, and 22, 1878, April 4, 1878); St. Germana (January 1, 1879); St. Catharine Island (January 1, —); Sapelo Island (December 15, 1883).

SOUTH CAROLINA: Mount Pleasant (April 5, 1904, May 17, 1904, November 4, 1904, October 19, 1896); Frogmore (May 5, 1885); Christ Church Parish (May 6, 1911); Porchers Bluff, Christ Church Parish (April 29, 1911, May 6 and 12, 1911); Charleston (January 10 and 11, 1891); Santee Club, lower South Santee River (June 10, 1915); St. Helena Island (November 22, 1904); Stoner River (November 9, 1904); Warsaw Island (November 28, 1904).

#### RALLUS LONGIROSTRIS CREPITANS Gmelin

##### NORTHERN CLAPPER RAIL

[*Rallus*] *crepitans* GMELIN, *Systema naturae*, vol. 1, pt. 2, p. 713, 1789, before Apr. 20 ("Noveboraco") (based on "Clapper Rail" Pennant, *Arctic zoology*, vol. 2, p. 490, no. 407, 1785 ["New York"]); and "Clapper Rail" Latham, *A general synopsis of birds*, vol. 3, pt. 1, p. 229, no. 2, 1785 ["New York"]).

*Subspecific characters*.—Similar to *Rallus longirostris waynei*, but tarsus and middle toe longer; wing and tail somewhat longer; upper parts lighter and more uniform; lower surface lighter, less ashy (more cinnamonaceous); white bars on the flanks averaging wider.

*Description*.—Adult: Iris raw umber or pale yellow; eyelids whitish; bill dull brown, the upper half of maxilla darker, the mandible and the edges of the maxilla rather yellowish brown; legs and feet grayish brown; claws darker. Nestling: Glossy black above with a metallic greenish sheen; duller with little or no gloss on the middle of the lower surface; basal half of bill blackish, the terminal half paler.

*Measurements*.—Adult male<sup>67</sup>: Wing, 142.5–159.5 (average, 151.1) mm; tail, 55–69 (64.6); exposed culmen, 55–69.5 (63.3); tarsus, 48–56 (51.7); middle toe without claw, 45.5–53.5 (48.8). Adult female<sup>68</sup>: Wing, 135.5–160 (146.8); tail, 55–69.5 (61.9); exposed culmen, 53.5–67 (59.6); tarsus, 41–56 (48.1); middle toe without claw, 40–52 (45.9).

<sup>66</sup> Type.

<sup>67</sup> Twenty-one specimens, from New York, New Jersey, Massachusetts, Virginia, and North Carolina.

<sup>68</sup> Seventeen specimens, from New York, New Jersey, Virginia, and North Carolina.

*Type locality*.—Hempstead, Long Island, N. Y.<sup>69</sup>

*Geographic distribution*.—Atlantic coast of the United States. Breeds north to southern Connecticut (Saybrook) and south to central eastern North Carolina (Beaufort). Winters north to southeastern New York (Far Rockaway, Long Island), southern Connecticut, casually in southeastern Massachusetts (Kingston), and south to northeastern Florida (Amelia Island). Casual in northeastern Massachusetts, southeastern New Hampshire (Portsmouth), and southwestern Maine (York). Accidental in northwestern Vermont (Burlington); central western Virginia (Lexington); southeastern New York (Ossining); District of Columbia (Washington); and in the central eastern Bahama Islands (Watlings Island).

*Remarks*.—Notwithstanding its geographical separation, *Rallus longirostris crepitans* is in appearance very much like *Rallus longirostris corrius* from the Bahama Islands, but it is distinguishable from that race by its somewhat longer wing, longer bill and tarsus, as well as decidedly darker upper and lower surfaces. It may be distinguished from *Rallus longirostris longirostris* by larger size, lighter upper surface with less blackish centers of the feathers, and usually darker, more purely grayish sides of head; and from *Rallus longirostris leucophaeus* by its rather longer wing and tail, much shorter tarsus, paler, less grayish upper surface with less blackish (more brownish) centers of the feathers, paler, less blackish flanks and sides, with much wider white bars, and the paler, duller, and less pinkish (more buffy) cinnamonaceous of lower parts.

Birds of this race from Smith, Cobb, and Isaacs Islands in Virginia are apparently typical in both size and color. A single bird from Charleston, S. C., taken on June 8, 1902, is evidently typical *Rallus longirostris crepitans*, but it doubtless represents a bird that had remained behind the northward bound migrants. Several breeding birds from central eastern North Carolina at Fort Macon, Hatteras, Pea Island, New Inlet, and Beaufort, are geographically and otherwise intermediate between *Rallus longirostris crepitans* and *Rallus longirostris waynei*, and although more grayish on the upper surface are not much darker than specimens of *Rallus longirostris crepitans* from New Jersey. While these birds are thus appreciably different from typical *Rallus longirostris crepitans* they are so close to this form that it seems best, at least for the present, to refer them to this race, rather than to give them a distinctive name.

Individual variation in this race is considerable but is not so marked as in some of the others. In the adult the throat varies from pure

<sup>69</sup> The New York specimens in Mrs. Blackburn's Museum, which Pennant and Latham cited as the basis of their descriptions, were sent by a correspondent who lived at Hempstead, Long Island, N. Y., so that in this as in other similar cases this place should be considered the type locality.

white to buff; the breast from pale ochraceous, almost without a pinkish cinnamon tinge, to pinkish cinnamon; the jugulum is sometimes gray on the median area and sometimes without gray even on the sides; the flanks range from very light gray to rather deep grayish brown; the lower tail-coverts are either heavily or lightly barred or spotted; the bars on the flanks range in width from 1.2 to 4 mm, averaging about 3 mm; and the edgings of the back, scapulars, and the rest of the upper surface vary from almost pure gray to olive gray, the centers of the feathers from light olive brown to bistre, and even occasionally to clove brown. There are about four fairly well-defined color phases, although they are not so well marked as in *Rallus longirostris saturatus*. There is a light grayish phase with gray jugulum; a light grayish phase, with cinnamon-buff jugulum; a dark olivaceous phase with a grayish jugulum; and a dark olivaceous phase with a cinnamon-buff jugulum. In the light phases the upper parts are relatively uniform, because of less difference between the centers of the feathers and the edgings. In the light grayish phase the upper parts have rather pure gray edgings, but in the dark olivaceous phase the edgings are olive gray.

Individual differences in the juvenal plumage are almost as conspicuous as in the adults, the upper parts varying from purely grayish to dull brownish, the lower parts from almost pure white on the throat and abdomen to a strongly buffy or cinnamomeous or even pinkish tone.

The following specimens have been examined by the writer:

CONNECTICUT: New Haven (September 10, 1884); Stamford (June 17, 1893); West Haven (May 30, 1904).

FLORIDA: Amelia Island (January 11, 1906, September 6, 7, and 13, 1906).

GEORGIA: St. Marys; Sapelo Island (December 16, 1887); Savannah.

MARYLAND: Point Lookout (September 8, 1880).

MASSACHUSETTS: Ipswich (October 20, 1910).

NEW JERSEY: Tuckerton (June 18, 1918, nestling); Cape May (May —, 1842, May 6, 1880, May 15, 1877, May 20, 1881, May 22, 1882, May 14, 1881); Avalon (September 22, 1902); Atlantic City (July 23, 1893, May 14, 1881, October 2, 1894); South Amboy (May 12, 1879); Brigantine (June 3, 1882).

NEW YORK: Amityville (June 28, 1887, September 3, 1898); Somers Point (August 29, 1887); Hempstead Bay (September 13, 1907); Freeport (May 30, 1913, July 10, 1913, August 9, 16, and 18, 1913, July 11, 1901); near New York City (August 27, 1908, August 29, 1909).

NORTH CAROLINA: Fort Macon (April 22, 1869, April 11, 1891); Hatteras (March 2, 3, 6, and 7, 1900, April 3, 7, and 24, 1900, May 5, 1900, January 13, 1900, November 7 and 12, 1899, August 20 and 25, 1900, November 6 and 7, 1900); Beaufort (September 15, 1932, October 18, 1932, May 30 and 31, 1932); New Inlet (August 19, 30, and 31, 1904); Pea Island (May 1, 2, 5, 8, and 10, 1902, February 9, 11, 13, and 16, 1901, December 17, 1908, May 20, 1901, August 11, 19, 24, 30 and 31, 1904, January 16, 1904, December 17, 1904).

SOUTH CAROLINA: Stoner River (November 4 and 9, 1904); St. Helena Island (November 22, 1904); Port Royal (February 10, 1891); Lady Island; Mount Pleasant (June 8, 1902, January 10 and 11, 1891).

VIRGINIA: Smith Island (September 6, 7, 10, and 11, 1899, September 17, 1898, June 10, 1897, May 24, 1898, May 3, 10, 12, 20, and 23, 1899, April 30, 1899, August 18, 1899); The Isaacs (May 24, 1899); Cobb Island (June —, 1881, June 25 and 28, 1907, June 30, 1890, July 9, 1881, July 13, 1899, July 16, 1884, July 23, 1880); Lexington (autumn, 1928); Wachapreague (May 13, 1913); Bone Island (July 14, 1880).



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MOTHS OF THE GENUS RUPELA (PYRALIDIDAE:  
SCHOENOBIINAE)

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Agriculture*

THIS paper is based upon specimens of pyralidid moths in the United States National Museum, the British Museum, the American Museum of Natural History, and the Cornell University collection. I am indebted to these institutions for the loan of specimens, to Dr. W. T. M. Forbes for the specimens collected by him in the Guianas, to Dr. H. E. Box for the gift of reared specimens from British Guiana and St. Lucia, and especially to W. H. T. Tams for giving me the correct application of the Walker and Zeller names. He made preparations of the genitalia of the Walker and Zeller types in the British Museum, compared them with drawings and slides that we submitted, and sent me photographs of the type slides and helpful notes on the types. I am obliged to him also for the loan of the British Museum material.

Studies of the genitalia in this genus brought surprising results. What we thought were but two or three white species proved to be at least 18 species, sharply defined on characters of the male and female genitalia, but so alike in color and so variable in size and in what ordinarily are specific differences in venation that they could not be separated by external characters. Needless to say, the specimens in the various collections were badly mixed, and no reli-

ance could be placed upon the references in literature to the older species. Therefore, I have omitted all but original references in the synonymy. Distribution as given in this paper is only for specimens I have examined.

Among the male specimens I recognize 20 species, and among the female specimens also 20. Unfortunately, in only five species could males and females be definitely associated. Therefore, it was necessary to give separate names to the unassociated males and females representing undescribed species. I regret having to do this, for eventually some of the new names will have to go into synonymy; but it may be many years before the sexes are associated, and meanwhile we shall need names for the females as well as the males. Some temporary double naming is unavoidable.

Thirty-one species are described as new, 2 from both sexes, 14 from males only, and 15 from females.

Two old names are placed in synonymy.

#### Genus RUPELA Walker

##### PLATE 33

*Rupela* WALKER. List of the specimens of lepidopterous insects in the collection of the British Museum, vol. 28, p. 523, 1863.—DYAR, Insecutor Inscitiae Menstruus, vol. 5, p. 80, 1917. (Genotype: *Rupela nivea* Walker.) *Storteria* BARNES and McDUNNOUGH, Contr. Nat. Hist. Lepid. North America, vol. 2, no. 4, p. 178, 1913.—DYAR, Insecutor Inscitiae Menstruus, vol. 1, p. 105, 1913. (Genotype: *Storteria unicolor* Barnes and McDunnough.)

Labial palpus upturned; basal segment clothed beneath with long hairlike scales; third segment short, acuminate. Maxillary palpus well developed, filiform, with scales at apex slightly dilated. Antenna minutely serrate and pubescent, laterally flattened. Thorax with expanding hair tuft from tegula. Fore wing with termen evenly curved; 12 veins; 2 and 3 from cell before angle; 4 and 5 from lower angle of cell, approximate, connate or stalked; 6 and 7 from cell, separate; 10 from the stalk of 8 and 9; 11 from the cell, separate from, approximate to, or anastomosing with 12. Hind wing with 8 veins; 4 and 5 from lower angle of cell, approximate, connate or stalked. Abdomen long; in female with large, expanded anal tuft; eighth abdominal sternite of male with several sclerotized areas and seventh sternite with a central sensory scale tuft on caudal margin (pl. 33, fig. 45); seventh abdominal sternite of female with a central longitudinal sclerotized area more or less developed (pl. 33, figs. 44, 46).

Male genitalia symmetrical; uncus stout, basal part enlarged and variously modified; gnathos strong, with central area produced caudally and strongly sclerotized (beaklike) or thin and only more

or less broadened, not produced caudally (bandlike); harpe with basal costal process produced, cucullus weakly sclerotized and simple; transtilla, when distinguishable, seldom sclerotized throughout; anellus with shieldlike ventral plate (juxta) and a more or less sclerotized dorsal part, which is frequently armed with spines; aedeagus moderately long, cylindrical, straight or only slightly bent, penis entrance well forward of base; cornuti rarely present; vinculum narrow, only slightly produced beyond base of harpe; from inter-segmental membrane attaching to base of vinculum, a pair of fine, moderately long hair tufts.

Female genitalia with bursa copulatrix elongate, very weakly sclerotized, simple, with no trace of signa; ductus bursae sclerotized toward genital opening; area about genital opening always more or less sclerotized, often with a well-developed and deeply pigmented genital plate; ovipositor rods moderately long; rods of eighth segment collar of abdomen about twice the length of ovipositor rods, strong.

This genus, as far as I know, is confined to the New World. It contains all the white and two of the nonwhite American species formerly referred to *Topeutis* (= *Scirpophaga*). Five tropical American species (*bivittata* Möschler, *perstrialis* Hübner, *repugnatalis* Walker, *terrella* Hampson, and *irrorata* Hampson) are still properly referable to *Topeutis* on venational and palpal characters. These are all brown species or have the forewings banded with brown. One of the *Rupela* species has a brown form (*tinctella* Walker) and another (*pallidula*, new species) has gray-tinted forewings and fuscous hind wings. All the other species are white and not to be distinguished from each other except by their genitalia.

*Rupela* is apparently closely allied to *Topeutis*, from which it differs in having upturned labial palpi and vein 10 of fore wing from the stalk of 8-9. In *Topeutis* the palpi are porrect and vein 10 is from the cell; very rarely (in a few specimens of *terrella* Hampson) is vein 10 short stalked with 8-9. These differences were noted by Dyar in 1913 when he removed *Rupela* from the synonymy of *Scirpophaga*, where it had been placed by Hampson in 1896.

The males divide into two distinct groups, one having a bandlike gnathos and yellow anal tuft, the other a beaklike gnathos and white anal tuft. If a corresponding character can be found in the female genitalia it may be possible to remove the species with the bandlike gnathos from *Rupela* and give them a separate generic designation; but as yet we have no females definitely associated with males in this group and, therefore, are not justified in erecting a new genus.



There appear to be good specific differences in the shape and size of the bursa copulatrix, but, while this organ has been carefully figured in each case, I have not attempted to use it to define species. There are plenty of other more obvious characters in the female genitalia, and the bursa is so subject to distortion in preparation, so difficult to see in balsam, and subject to so much individual variation in size or shape that the attempt to use it in classification of species would confuse rather than help our definitions.

## KEY TO THE SPECIES OF RUPELA

*Males*

1. Gnathos with central area caudally produced and strongly sclerotized (beaklike). Anal tuft white----- 2  
    Gnathos with central area not caudally produced, thin (bandlike). Anal tuft yellow----- 13
2. Dorsal element of anellus spined----- 3  
    Dorsal element of anellus unspined----- 9
3. Uncus laterally compressed at apex----- 4  
    Uncus not laterally compressed at apex----- 5
4. Aedeagus finely scobinate on venter near apex-----leucatea (p. 360)  
    Aedeagus spined on lateral margins at apex-----segrega (p. 366)  
    Aedeagus with pronounced lateral spur at apex-----pallidula (p. 365)
5. Tegumen with projecting spur from each ventrolateral margin-----scitula (p. 374)  
    Tegumen simple----- 6
6. Penis bearing a line of minute cornuti-----liberta (p. 364)  
    Penis without cornuti----- 7
7. Aedeagus with ventral scobinations near apex. One pair of long, stout spines on anellus-----cornigera (p. 371)  
    Aedeagus with one lateral margin near apex weakly serrate.  
       Spines on anellus numerous, small, scattered-----albinella (p. 362)  
    Aedeagus with apex smooth and labeose; anellus with two or three pairs of minute spines-----labeosa (p. 363)  
    Aedeagus with sclerotized manica, otherwise simple; spines on anellus stout, rather short in a single cluster or in a pair of dense combs----- 8
8. Spines of anellus a single cluster at one side of dorsal membranous part-----gibbera (p. 367)  
    Spines of anellus arranged as an opposing pair of dense, dark combs-----saetigera (p. 367)
9. Sacculus of harpe produced at apex into a long, stout spine (clasper)----- 10  
    Sacculus not so produced----- 11
10. Clasper a straight spine-----nivea (p. 370)  
    Clasper a curved spine-----vexativa (p. 371)
11. Basal part of uncus scobinate and produced backward (cowllike)----- 12  
    Basal part of uncus without spines or scobinations, not produced backward-----tinctella (p. 368)
12. Aedeagus with apical half greatly narrowed (rodlike). Cucullus of harpe narrow-----sejuncta (p. 373)

- Aedeagus with lateral flange at apex. Cucullus of harpe broad.....imitativa (p. 372)
13. Penis bearing a small, serrate cornutus. Dorsal part of anellus consisting of a pair of strongly sclerotized, sinuous, irregularly serrate plates.....horridula (p. 376)
- Penis without cornutus. Dorsal part of anellus membranous..... 14
14. Apex of aedeagus produced into curved clawlike hook or hooks..... 15
- Apex or aedeagus very slightly produced, but not into hooks or claws..... 16
15. Apex of aedeagus produced into a single, stout, curved, blunt hook.....adunca (p. 374)
- Apex of aedeagus produced into three heavy claws.....lumarina (p. 375)
16. Base of uncus produced backward into forklike process with stubby, spined prongs.....monstrata (p. 377)
- Base of uncus produced backward into a broad concave plate bearing numerous heavy, long, curved spines.....spinifera (p. 377)

*Females*

1. Genital plate a narrow semicircular band firmly joined to rods of eighth segment collar.....tinctella (p. 368)
- Genital plate not a semicircular band, nor attached to rods of eighth segment collar..... 2
2. In area caudad of genital opening a small, sclerotized nipple.....sejuncta (p. 373)
- In area caudad of genital opening an external sclerotized pocket..... 3
- In area caudad of genital opening an internal sclerotized pocket..... 5
- From area just caudad of genital opening a strongly sclerotized, projecting, hooked process..... 6
- Area caudad of genital opening smoothly sclerotized or rugose, without pockets or protruding processes..... 7
3. Genital plate in the form of a stout, blunt, thornlike process in front of genital opening.....lara (p. 382)
- Genital plate otherwise..... 4
4. Genital opening irregular, more square than circular.....procula (p. 384)
- Genital opening nearly circular.....jana (p. 381)
5. Genital plate large, completely surrounding genital opening.....candace (p. 382)
- Genital plate not surrounding genital opening; appressed to and no wider than ductus bursae.....orbona (p. 384)
6. Projecting process from behind genital opening truncate. Ductus bursae greatly expanded toward genital opening.....maenas (p. 383)
- Projecting process bluntly pointed. Ductus bursae not greatly expanded toward genital opening.....nereis (p. 383)
7. Just within genital opening (from lower margin of the opening) a pair of short, dark, hooklike processes.....faustina (p. 380)
- Just within genital opening a pair of sclerotized disks.....gaia (p. 380)
- No hooks, disks, or other processes within genital opening..... 8
8. Ductus seminalis forming a loop with ductus bursae just before genital opening.....edusa (p. 379)
- Juncture of ductus seminalis and ductus bursae otherwise..... 9
9. Lower margin of genital opening sinuate.....leucatea (p. 380)
- Lower margin of genital opening angulate or concave..... 10

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|--|--------------------|
| 10. Lower margin of genital opening slightly concave.....                              | 11                 |
| Lower margin of genital opening deeply concave or angulate.....                        | 12                 |
| 11. Without defined genital plate. Genital opening of moderate width .....             | antonia (p. 378)   |
| With genital plate well defined. Genital opening very wide (as wide as the plate)..... | segrega (p. 366)   |
| 12. With defined genital plate.....  | 13                 |
| Without defined genital plate.....   | bendis (p. 378)    |
| 13. Genital plate completely surrounding genital opening; latter moderately wide ..... | 14                 |
| Genital plate not surrounding genital opening; latter as wide as the plate .....       | drusilla (p. 379)  |
| 14. Genital plate rugose, especially toward caudal margin.....                         | herie (p. 381)     |
| Genital plate smooth.....  | 15                 |
| 15. Bursa copulatrix very short, much reduced.....                                     | canens (p. 379)    |
| Bursa copulatrix normal.....   | albinella (p. 362) |

RUPELA LEUCATEA (Zeller)

PLATE 22, FIGURES 1-1*d*; PLATE 30, FIGURE 30; PLATE 33, FIGURES 44, 45, 48

*Scirpophaga leucatea* ZELLER, Chilonidarum et crambidarum genera et species, p. 2, 1863; male and female.

*Scirpophaga longicornis* MÖSCHLER, Abh. Senck. naturf. Ges., vol. 16, p. 321, 1890 (new synonymy); male and female.

Zeller described his *leucatea* from Brazil and St. Thomas. Later<sup>1</sup> he recorded it from Puerto Rico, Mexico, and Panama. I omit the latter reference from the synonymy, as it is quite likely that he had a mixed series before him. Until genitalia of all his paratypes are examined we can be sure only of his West Indian specimens and the actual type. Mr. Tams has examined the genitalia of the latter and checked them with my figures. I am indebted to him for the identifications. As far as we know there is only one pure white species of *Rupela* found in the Antilles; therefore *longicornis* Möschler is presumably the same as *leucatea*.

*Male*.—Wings shining white. Fore wing with veins 11 and 12 separate; 4 and 5 connate or shortly stalked. Hind wing with 4 and 5 connate or stalked. Anal tuft white.

Alar expanse, 22-38 mm.

Genitalia with gnathos beaklike but having rather prominent lateral arms; in ventral aspect with basal half rounded (central part of lower margin convex); apical half tapering to blunt point; apex not appreciably upturned; inner surface near apex finely scobinate. Uncus stout; basal portion broad with moderately wide dorsal groove; laterally compressed on dorsum at apex; from side view, apex broad, slanting; viewed from beneath, triangularly pointed. Harpe widest just before middle, very slightly tapered to broadly

<sup>1</sup> Horae Soc. Ent. Rossicae, vol. 13, p. 6, 1877.

rounded apex; basal costal process triangularly produced, not strongly sclerotized; sacculus very slightly produced at apex. Anellus consisting of ventral plate and a rugose dorsal piece, the latter bearing three minute spines on each of the ends attached to aedeagus; ventral plate with lateral margins concave. Aedeagus cylindrical, constricted somewhat at outer third, expanded laterally just before apex and finely scobinate on venter near apex.

*Female*.—Wing color and venation as in the male except that veins 11 and 12 are slightly anastomosed in one specimen. Anal tuft yellow.

Alar expanse, 25–53 mm.

Genitalia without defined genital plate but with area between genital opening and collar sclerotized and markedly rugose; lower margin of genital opening sinuate; ductus bursae sclerotized only at genital opening.

*Types*.—In British Museum (*leucatea*); Berlin Museum (*longicornis*).

*Type localities*.—Rio de Janeiro, Brazil (*leucatea*); Puerto Rico (*longicornis*).

*Food plant*.—*Echinochloa polystachya*. This food-plant record is from specimens reared by Dr. H. E. Box, St. Lucia, October 2, 1934.

*Distribution*.—JAMAICA; CUBA, Baragua (May), Matanzas (August); HISPANIOLA, Sanchez (May, June), Rio Yaque (February); PUERTO RICO, Santa Rita (July), Mayaguez (December), Bayamon (June), Catano (July), Rio Piedras (December), Dorado (May), Desengano (May, December), Toa-Baja (January, February); GUADELOUPE (December); GRENADA, Balthazar; MARTINIQUE; ST. LUCIA, Rosseau (August, September, October); ANTIGUA, Bendals (October); MEXICO, Teapa (Tabasco, January); GUATEMALA, Quirigua (October); HONDURAS; NICARAGUA; PANAMA, La Chorrera (April, May); TRINIDAD; VENEZUELA, Aroa; FRENCH GUIANA, St. Jean Maroni; BRITISH GUIANA, Georgetown (July), Kartabo (October), Mackenzie (June); SURINAM, Moengo (May), Para District (April), Paramaribo (May); BRAZIL, Rio Madeira (July–August), Tapera, Rio Campo Bello, Rio Jurna (July), Reyes (Beni River, July), Prainho (November), Itatoro (Rio Madina, February), Maranhao; ARGENTINA, Villa Ana "F.C.S.F." (February, March, December); PARAGUAY, Villarrica (March), Sapacay (September, November), Rio Pacaya (July); PERU, Madre de Dios.

*Remarks*.—One hundred and nine specimens (48 males and 61 females) examined, from the collections of the United States National Museum, British Museum, Cornell University, and American Museum of Natural History.

The species is readily identifiable by the scobinate aedeagus and apically compressed uncus of the male, the distinct rugosity of the membranous area behind the genital opening, and the sinuate margin of the genital opening in the female.

RUPELA ALBINELLA (Cramer)

PLATE 22, FIGURES 2-2*d*; PLATE 29, FIGURES 26-26*b*

*Scirpophaga albinella* CRAMER, *Papillons exotiques des trois parties du monde* . . . , vol. 4, pl. 372, fig. D, 1781; female.

Cramer's figure would fit almost any of the white species with yellow anal (female) tuft treated in this paper, and the name has been indiscriminately applied. Inasmuch as the type is nonexistent, I am fixing the name to the species apparently most abundant in the type locality. Dr. W. T. M. Forbes captured a male and female in copula, and we are therefore able to associate the sexes.

*Male*.—Wings white. Fore wing with veins 11 and 12 separate or, for a short distance, closely approximate; 4 and 5 connate or shortly stalked. Hind wing with 4 and 5 connate or stalked. Anal tuft white.

Alar expanse, 20-34 mm.

Genitalia with gnathos beaklike but having rather prominent lateral arms (attaching to tegumen); in ventral aspect basal half rounded (central part of lower margin convex); apical half tapering slightly to bluntly pointed apex; apex upturned (lateral view); inner surface (under high magnification) finely granulate, not spined or serrate. Uncus moderately stout; basal part with central dorsal excavation; a short but prominent dorsal keel near base; apical half digitate, very slightly broadened near apex; apex rounded. Harpe with lower margin indented near cucullus; apex rounded; basal process of costa not strongly sclerotized nor much produced; sacculus without apical projection, simple. Anellus consisting of ventral plate and a rugose, sclerotized dorsal piece, the latter bearing several small, inconspicuous spines; ventral plate with lateral margins concave. Aedeagus cylindrical, slightly widened at apex; one lateral margin near apex weakly serrate.

*Female*.—Wing color and venation as in the male. Anal tuft yellow.

Alar expanse, 27-45 mm.

Genitalia with genital plate well defined, sclerotized, its caudal margin angulate; genital opening rigid, its lower margin semicircular; ductus bursae strongly sclerotized toward genital opening. There is some variation in the size of the genital opening and in the width of the ductus in specimens from different localities—especially

as between larger specimens from central Brazil and smaller females from the Guianas and Central America. I am unable, however, to find any characters that would seem to indicate distinct races.

*Type*.—Lost.

*Type locality*.—Surinam.

*Distribution*.—MEXICO, Presidio, Atoyac (Veracruz), Teapa (Tabasco), Misantla (May); BRITISH HONDURAS, Cayo; GUATEMALA, Quirigua (April), Tiquisati (May), Volcan Sta. Maria (March); HONDURAS, Lancetilla (June); COSTA RICA (April), Port Limon (January), Sixola River (September); PANAMA, Bugaba, David, Tabernilla, Cabima (May), Rio Trinidad (June), Corozal (August); TRINIDAD, St. Augustine (November); FRENCH GUIANA, St. Laurent Maroni, St. Jean Maroni; BRITISH GUIANA, Georgetown (July, November), Mackenzie (June); SURINAM, Paramaribo (April, June), Moengo (May), Surinam River (St. Barbara Plantation, April); BRAZIL, Manaus, Pernambuco, Parintins (June), Parana de Buyassu (January), Itacoatiara (November), Breves (January), Para, Urucaca (November), Rio Jurna (November), Rio Jutatie (January), Rio Madeira (May), Faro (April), Pariti (Rio Purus, October), Ponte Nova (Rio Xingu), Taperinha, Sao Paulo de Olivenca (November-December), Amazon River between Teffe and Tonantins (November); COLOMBIA, Magdalena Valley, Rio Condeto (Choco, December); ECUADOR (no other locality); PERU, Rio Ucayali (December).

*Remarks*.—One hundred and eight specimens (33 males and 75 females) examined, from United States National Museum, British Museum, and Cornell University collections.

The species is easily identified by the serrations on the apical end of the aedeagus, the spining on the dorsal plate of the anellus, the dorsal keel on the uncus, and the peculiarly shaped female genital plate and genital opening.

RUPELA LABEOSA, new species

PLATE 22, FIGURES 3-3d

*Male*.—Wings white. Fore wing with some dark shading on under side in costal area above cell; veins 11 and 12 approximate (but nowhere touching); 4 and 5 closely approximate or connate. Hind wing with 4 and 5 closely approximate or connate. Anal tuft white.

Alar expanse, 19-21 mm.

Genitalia with gnathos beaklike but having rather long lateral arms (forming attachments to tegumen); in ventral aspect basal half broadly rounded, apical half narrow, tapering to apex; inner surface finely serrate toward apex. Uncus stout; basal part very

broad, somewhat bulged but not extended backward into cowl-like lobe, its central dorsal area evenly excavate; apical half digitate; apex blunt and slightly hooked. Harpe with apex rounded (cucullus tapering); basal process of costa produced (the basal processes of the right and left harpes fusing to form a complete, sclerotized transtilla); sacculus folded upward toward apex (an appreciable depression in harpe just above sacculus). Anellus consisting of ventral plate and a sclerotized, somewhat roughened dorsal piece, the latter with a very few minute spines (2 or 3) on the ends attached to aedeagus. Aedeagus cylindrical, smooth; apex flaring into a wide mouth (labeose).

*Type and paratypes*.—U.S.N.M. no. 51856. Paratypes also in British Museum.

*Type locality*.—Castro, Paraná, Brazil.

*Remarks*.—Described from male type and six male paratypes from the type locality (four specimens collected by Wm. Schaus, three by E. D. Jones, no dates).

Easily recognized by its labeose aedeagus and completely formed transtilla.

Female unknown.

**RUPELA LIBERTA, new species**

PLATE 23, FIGURES 4-4c

*Male*.—Wings white. Fore wing with veins 11 and 12 anastomosing; 4 and 5 connate. Hind wing with 4 and 5 connate. Anal tuft white.

Alar expanse, 20-25 mm.

Genitalia with gnathos beaklike; lateral arms developed; in ventral aspect with basal half rounded (central part of lower margin deeply convex); apical half rather narrow, not appreciably tapering; apex bluntly pointed; in lateral aspect gnathos distinctly upcurved. Uncus with basal part broad and stout and deeply, evenly, and rather widely excavate; apical half digitate; apex rounded. Harpe slightly narrowed at cucullus; apex rounded; basal process of costa produced into short digitus; sacculus produced at apex as a rather prominent upfolded ridge. Anellus consisting of ventral plate and a strongly sclerotized dorsal band, which partially encircles aedeagus; each extremity of dorsal band bearing a cluster of very dark, moderately long, stout spines; ventral plate with upper margin broadly incised and lateral margins concave. Aedeagus cylindrical, rather slender, of nearly equal width throughout, a few minute scobinations on under surface near apex; penis bearing a thin, short line of minute cornuti.

*Type and paratypes*.—U.S.N.M. no. 51857. Paratype also in British Museum.

*Type locality*.—Durango, Mexico (C. C. Hoffman, "276").

*Remarks*.—Described from type and one paratype from the type locality, one paratype from Colima, Mexico (Schaus, collector), one paratype from Jalapa, Mexico (Schaus), and one paratype from Cabima, Panama (A. Busck, May 20, 1911).

The species may be recognized by the characteristic spining of the dorsal part of the anellus and the line of fine cornuti on the penis. Only two of the species treated in this paper show any trace of cornuti or a cornutus.

Female unknown.

RUPELA PALLIDULA, new species

PLATE 23, FIGURES 5-5d

*Male*.—Head and palpi as in the pure white species. Thorax white but with collar darker, concolorous with fore wing. Fore wing silvery buff, unicolorous; cilia snow white; veins 11 and 12 separate; 4 and 5 stalked. Hind wing darker than fore wing, gray to grayish brown, cilia snow white; veins 4 and 5 stalked. Wings concolorous beneath, grayish brown. Anal tuft white.

Alar expanse, 24-32 mm.

Genitalia with gnathos beaklike but with lateral arms well developed; basal. projecting part rather narrow, truncate; inner surface very finely scobinate; apex upturned. Uncus with basal part humped, subquadrate, rather deeply grooved posteriorly and somewhat rugose; apical half digitate, laterally compressed on dorsum at apex. Harpe tapering slightly at apex; apex rounded; basal process of costa greatly produced, digitate (the basal processes of the two harpes united by a bit of membrane at their apices); sacculus produced at apex into a minute spine. Anellus consisting of ventral plate and dorsal membrane, the latter bearing two pairs of short, stout spines; ventral plate broadly incised on upper margin, lateral margins concave. Aedeagus with a pronounced lateral spur at apex.

*Type and paratypes*.—U.S.N.M. no. 51858. Paratypes also in British Museum.

*Type locality*.—Castro, Paraná, Brazil.

*Remarks*.—Described from male type and 12 male paratypes from the type locality and 1 male paratype from Sao Paulo, Brazil.

The above were in the National Museum collection and British Museum identified as *tinctella* Walker. The species is easily recognized by its color, the spining of the anellus, and its characteristic aedeagus.

Female unknown, probably white.



## RUPELA SEGREGA, new species

PLATE 23, FIGURES 6-6d; PLATE 30, FIGURE 32

*Male*.—Wings shining white. Fore wing with veins 11 and 12 separate; 4 and 5 approximate or connate. Hind wing with 4 and 5 connate or stalked. Anal tuft white.

Alar expanse, 26–33 mm.

Genitalia with gnathos beaklike but with lateral arms (attaching to tegumen) developed; posterior margin of central basal part rounded; inner surface finely scobinate; apex upturned. Uncus with basal part slightly humped, stout, subquadrate, deeply excavate posteriorly and dorsally; apical two-thirds digitate, laterally compressed on dorsum at apex (as in *leucatea* and *pallidula*). Harpe simple; cucullus but slightly narrowed; basal process of costa moderately produced, fusing with a very weakly sclerotized transtilla; sacculus not produced at apex. Anellus consisting of ventral plate and a somewhat roughened dorsal piece, the latter bearing one pair of long, stout spines and two pairs of shorter spines; ventral plate with upper margin incised, lateral margins deeply incised. Aedeagus with apex cleft, laterally expanded and spined on lateral margins.

*Female*.—Wing color and venation as in the male. Anal tuft white.

Alar expanse, 28–38 mm.

Genitalia with genital plate well defined and somewhat similar to that of *albinella* but with caudal margin more acutely angled; genital opening almost as wide as plate, the lower (outer) margin concave; ductus bursae strongly sclerotized (and brown) for a short distance from genital opening.

*Type and paratypes*.—U.S.N.M. no. 51859. Paratypes also in British Museum.

*Type locality*.—South Bay, Lake Okeechobee, Fla.

*Remarks*.—Described from male type, eight male and five female paratypes, the paratypes distributed as follows: FLORIDA, Glenwood, one male, Fort Meade (April), two males and one female, Coconut Grove (E. A. Schwarz), two males, Royal Palm State Park (F. M. Jones, March), one male (W. S. Blatchley, April) and one female, South Bay, one female, Dade City (September), one male, Biscayne Bay, one female; NORTH CAROLINA, Havelock on Lake Ellis (F. Sherman, June), one female; also one male without any locality label.

A North American species apparently confined to the southern part of the United States. Specimens of *segrega* (as well as *sejuncta* and white Florida females of *tinotella*) have hitherto been identified as *albinella* Cramer. The latter as far as I know does not occur in the United States.

## RUPELA GIBBERA, new species

## PLATE 24, FIGURES 7-7d

*Male*.—Wings shining white. Fore wing with veins 11 and 12 separate; 4 and 5 connate. Hind wing with 4 and 5 connate. Anal tuft white.

Alar expanse, 23 mm.

Genitalia with gnathos beaklike the lateral arms developed; central part rather broad and stubby, tapering slightly to bluntly pointed apex; inner surface evenly and markedly granulate. Uncus heavy; basal part subquadrate, humped, deeply excavate on dorsum, the margins of the excavations rugose; apical part digitate, apex bluntly pointed. Harpe with costal process short, the latter fusing into a partially sclerotized but appreciable and complete transtilla; cucullus very slightly tapered; apex rounded; sacculus produced at apex into an upturned, rounded, sclerotized, platelike protuberance. Anellus consisting of ventral plate and a membranous dorsal part; from one side of the latter projects a curved sclerotized band which bears at its extremity a single cluster of stout, short spines. Aedeagus with greatly elongated, dark, rigid manica (*Ma.*, pl. 24, fig. 7b); otherwise simple.

*Type*.—In Cornell University collection.

*Type locality*.—Moengo, Boven, Cortica River, Surinam (W. T. M. Forbes, May 23, 1927).

*Remarks*.—Described from one male. May be really identified by the uncus, the single lateral spine cluster on the anellus, and the enlarged and strongly sclerotized manica of the aedeagus.

Female unknown.

## RUPELA SAETIGERA, new species

## PLATE 24, FIGURES 8-8c

*Male*.—Wings shining white. Fore wing with veins 11 and 12 separate; 4 and 5 connate. Hind wing with 4 and 5 connate. Anal tuft white.

Alar expanse, 23 mm.

Genitalia with gnathos beaklike; lateral arms developed; central part with truncate lower margin; apical part tapering, apex pointed; inner surface with few and very weak granulations. Uncus heavy; basal part much enlarged, subquadrate, only slightly grooved on dorsum and with lateral-dorsal angles pointed and slightly produced; apical part rather short (in comparison to other species), tapering slightly, a central dorsal ridge running its entire length; apex blunt. Harpe constricted at cucullus; cucullus small, bluntly pointed; basal costal process slightly produced; sacculus broad, surface concave,

apex bluntly triangular and very slightly produced, free edge minutely serrate. Anellus consisting of ventral plate and dorsal membrane; the latter bearing an opposing pair of long, dense, very dark spine combs; spines numerous and moderately stout; lateral margins of ventral plate concave. Aedeagus slender, very slightly tapering; fused manica sclerotized for a short distance; otherwise simple.

*Type*.—U.S.N.M. no. 51860.

*Type locality*.—Castro, Paraná, Brazil (W. Schaus).

*Remarks*.—Described from one male. May be at once recognized by the bluntly triangular apex of the sacculus, the spine combs on the anellus, and the shape of the basal part of the uncus.

Female unknown.

#### RUPELA TINCTELLA (Walker)

PLATE 24, FIGURES 9-9c; PLATE 32, FIGURES 42, 43; PLATE 33, FIGURE 46

*Salapola tinctella* WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, vol. 28, p. 526, 1863; female.

*Scirpophaga zelleri* MÖSCHLER, Verh. zool.-bot. Ges. Wien, vol. 31, p. 435, 1882 (new synonymy); female.

*Scirpophaga holophaealis* HAMPSON, Ann. Mag. Nat. Hist., ser. 7, vol. 14, p. 181, 1904 (new synonymy); male.

*Storteria unicolor* BARNES and McDUNNOUGH, Contr. Nat. Hist. Lepid. North America, vol. 2, no. 4, p. 178, 1913; male.

*Rupela holophaealis* (HAMPSON) DYAR, Insecutor Inscitiae Menstruus, vol. 5, p. 80, 1917.

I am indebted to Mr. Tams for the identification of this species. He sent me a description and a photograph of the genitalia of Walker's type (a female) and compared a slide and a specimen I submitted. Möschler's species we know only from his description, but that leaves little doubt as to what he had before him. He says that the fore wing is "gelblich angehautes Weiss." This (since his type is a female) could apply only to the female of *tinctella*. Hampson's *holophaealis* I associate on the evidence of distribution and a female of *tinctella* in the National Museum collection, which matches in color the paler fuscous males of *holophaealis*. Dyar established the synonymy of *holophaealis* and *unicolor*. I have examined the genitalia of the Barnes and McDunnough type.

The species is extremely variable in color and venation and normally the males and females are sharply contrasted, the males being brownish ocherous and the females white. But this dimorphism is not constant. I have before me two males from Argentina (British Museum collection) that are almost pure white and not to be distinguished from the other white species except by genitalia. We have also one pale brown female from French Guiana. The genital characters are constant.

*Male*.—Head, thorax, fore and hind wings, and dorsum of abdomen pale brown or brownish ochereous (rarely white), some specimens paler than others and some with hind wing slightly darker than fore wing, normally with fore and hind wings concolorous. In the brownish specimens the dark shading extends to the palpi and legs. Fore wing with veins 11 and 12 separate; 10 sometimes very short stalked with 8 and 9; 6 more or less approximate to 7 at base (in other species 6 and 7 usually well separated and parallel); 4 and 5 separate or connate. Hind wing with 4 and 5 separate, connate or shortly stalked. Anal tuft very pale ochereous or white.

Alar expanse, 20–34 mm.

Genitalia with gnathos beaklike; lateral arms rather long; central part with truncate lower margin; apical part rather short, not tapering; apex bluntly rounded; inner surface finely granulate. Uncus with basal part very little widened and not at all humped (rather flattened); apical part tapering; apex blunt. Harpe simple; apex bluntly rounded; basal projection of costa produced, the projections of the two harpes joining at their apices to form a narrow transtilla. Anellus consisting of ventral plate and slightly roughened dorsal membrane; ventral plate elongate, its lateral margins notched. Aedeagus with basal half enlarged; without spines or serrations.

*Female*.—Head, thorax, and wings sordid white to pure white (rarely pale brownish ochereous); the fore wing frequently with a yellowish tint. Venation as in the male. Anal tuft yellow; the underlying scales black-brown and wavy (in other species the underlying scales are often dark brown or blackish but nearly always straight).

Alar expanse, 25–42 mm.

Genitalia with genital plate strongly sclerotized, forming a semi-circular band attached firmly to the rods of the eighth segment collar. Ductus sclerotized only at genital opening.

*Types*.—In British Museum (*tinctella* and *holophaealis*); Berlin Museum (*zelleri*); United States National Museum (*unicolor*).

*Type localities*.—Venezuela (*tinctella*); Paramaribo, Surinam (*zelleri*); Abaco, Bahamas (*holophaealis*); Everglades, Fla. (*unicolor*).

*Distribution*.—UNITED STATES, Florida, Everglades (April), Miami, Coconut Grove, Dade City, Panacea (August), St. Petersburg (April, July), Fort Meade (April), Grove (May); MEXICO, Huasteca (Veracruz); CUBA, Matanzas (April); BRITISH GUIANA, Georgetown (July); FRENCH GUIANA, St. Laurent Maroni, St. Jean Maroni; SURINAM, Geldersland (Surinam River), Kartabo (No-

vember); TRINIDAD (June); BRAZIL, Castro (Paraná); PARAGUAY, El Gran Chaco (November); ARGENTINA, Villa Ana (February, March).

*Remarks.*—Ninety-two specimens (54 males and 38 females) examined, from the collections of the United States National Museum, British Museum, and Cornell University.

The species is easily identified by male and female genitalia. In all the species I have seen there is none except *tinotella* that has the genital plate of the female fused to rods of the collar.

RUPELA NIVEA Walker

PLATE 25, FIGURES 10-10c

*Rupela nivea* WALKER. List of the specimens of lepidopterous insects in the collection of the British Museum, vol. 28, p. 524, 1863; male.

This species, though quite distinct in genital characters from anything else in the genus, has long been listed as a synonym of *albinella* Cramer. I am indebted to Mr. Tams for examining genitalia of Walker's type and giving me the correct identification.

*Male.*—Wings pure white. Fore wing with veins 4 and 5 closely approximate, connate or stalked; 11 and 12 closely approximate or anastomosing. Hind wing with 4 and 5 closely approximate, connate or stalked. Anal tuft white.

Alar expanse, 24-37 mm.

Genitalia with gnathos beaklike, heavy, smooth, broad at base (in ventral aspect), tapering to bluntly pointed apex. Uncus broad at base and tapering to apex, stout; basal part extended backward into bulbous lobe; from lateral view widest and slightly humped at middle (decidedly humped in specimen from Castro, pl. 25, fig. 10c). Harpe with apex tapering and rounded; basal process of costa (*Clh*) greatly extended, digitate; sacculus produced into clasper (*Cl*); the latter a long, stout, straight spine. Anellus consisting of a rigid ventral plate and a dorsal membrane which attaches to the aedeagus; upper (caudal) margin of plate deeply incised; membrane rugose, the wrinkles appreciably sclerotized. Aedeagus smooth; cylindrical; tapering slightly from beyond middle to apex.

*Type.*—In British Museum.

*Type locality.*—Pará (Santarem), Brazil.

*Distribution.*—PANAMA, Porto Bello (April, May); BRAZIL, Castro (Paraná); ARGENTINA, Gran Chaco (October), Villa Ana (January, February), Goya.

*Remarks.*—Twelve specimens examined. These are all males and are from the United States National Museum and British Museum collections. The Castro male (from the British Museum collection) is somewhat abnormal. The uncus is more appreciably humped than

in any of the other specimens and the clasper had a short secondary spine branching from its base. These differences are probably but individual abnormalities and, in my opinion, do not justify any separate name (varietal or otherwise) for the Castro specimen.

The female is unknown.

**RUPELA VEXATIVA, new species**

**PLATE 25, FIGURES 11-11c**

*Male*.—Wings pure white. Fore wing with veins 4 and 5 connate; 11 anastomosing with 12. Hind wing with 4 and 5 very shortly stalked. Anal tuft white.

Alar expanse, 27 mm.

Genitalia with gnathos beaklike, triangular, cleft from apex to middle. Uncus broad at base, tapering sharply to pointed and slightly hooked apex; basal part extended backward as a bulbous lobe (cowllike); dorsal surface of lobe with a few weak, scattered scobinations. Harpe with cucullus somewhat broadened toward apex; apex rounded; basal process of costa long, digitate; sacculus produced into clasper, the latter, a strong, stout spine, curved upward to costa. Anellus consisting of a rigid ventral plate and dorsal membrane; plate somewhat constricted at middle, lateral margins deeply incurved; membrane but slightly rugose, weakly sclerotized. Aedeagus smooth, bulging laterally just beyond middle, thence tapering rather abruptly toward apex; apex spatulate.

*Type*.—In British Museum.

*Type locality*.—Quirigua, Guatemala.

*Remarks*.—Described from one male collected by Wm. Schaus (April).

This species is easily recognized by its peculiar aedeagus, its cleft, triangular gnathos, and its strong, curved, hooklike clasper.

Female unknown.

**RUPELA CORNIGERA, new species**

**PLATE 25, FIGURES 12-12b**

*Male*.—Wings white. The wings are not so bright as in most of the other species, but their dullness may be due to the condition of the specimens. Under side of fore wing faintly dark shaded in costal area; veins 11 and 12 separate; 4 and 5 connate or shortly stalked. Hind wing with 4 and 5 connate or shortly stalked. Anal tuft white.

Alar expanse, 27-30 mm.

Genitalia with gnathos beaklike, tapering abruptly to middle, and gradually from middle to bluntly rounded apex. Uncus stout, basal part very broad and with central rib; apical two-thirds digitate;

apex bluntly rounded. Harpe approximately rectangular; basal process of costa somewhat produced but not strongly sclerotized, fusing into membranous transtilla; sacculus folded upward toward apex, not otherwise produced. Anellus consisting of ventral plate and a more strongly sclerotized U-shaped dorsal band; dorsal margin of ventral plate slightly concave; dorsal band bearing a pair of very long, stout spines. Aedeagus bent beyond middle; apical area ventrally compressed and slightly concave; the hind margin of this concave area armed with short thornlike scobinations; apex truncate.

*Type*.—U.S.N.M. no. 51861.

*Paratypes*.—In British Museum.

*Type locality*.—Castro, Paraná, Brazil.

*Remarks*.—Described from male type (Schaus, collector) and two male paratypes (E. D. Jones, collector) from the type locality. In addition to the above I have before me two small males belonging to the British Museum and collected at Obydos, Brazil, by E. E. Austin, February 2, 1896. They are smaller (18.5–20 mm) than the type series, and their genitalia are about half the size of those of typical *cornigera*. Otherwise there appears to be no difference. Possibly they represent a race. On the other hand, they may be merely stunted, aberrant specimens. Therefore I am not including them among the paratypes.

Female unknown.

RUPELA IMITATIVA, new species

PLATE 26, FIGURES 13–13c

*Male*.—Wings shining white. Fore wing with veins 11 and 12 approximate; 4 and 5 approximate. Hind wing with 4 and 5 connate or very shortly stalked. Anal tuft white.

Alar expanse, 36–38 mm.

Genitalia with gnathos beaklike; lateral arms developed; lower margin slightly convex; apical part stout, tapering to bluntly pointed apex; apex upturned; inner surface with a weak, central, longitudinal ridge. Uncus with basal part ovoid, produced backward (cowllike), finely and densely scobinate; apical part stout and but slightly tapered; apex bluntly pointed. Harpe with sacculus produced at apex into a strongly sclerotized fold; basal projection of costa produced, prominent; cucullus not narrowed, apex bluntly rounded. Anellus consisting of ventral plate and a slightly roughened dorsal membrane, ventral plate with upper margin concave, lateral margins widely and deeply concave. Aedeagus with basal part somewhat enlarged; apical half narrowing to blunt apex; apex with lateral flange.

*Type*.—In British Museum.

*Paratype*.—U.S.N.M. no. 51862.

*Type locality*.—Castro, Paraná, Brazil (E. D. Jones).

*Remarks*.—Described from male type and one male paratype from the type locality. May be recognized at once by the flanged aedeagus. Female unknown.

RUPELA SEJUNCTA, new species

PLATE 26, FIGURES 14–14c; PLATE 32, FIGURE 39

*Male*.—Wings shining white. Fore wing with veins 11 and 12 anastomosing; 4 and 5 connate. Hind wing with 4 and 5 connate or very shortly stalked. Anal tuft white.

Alar expanse, 28–33 mm.

Genitalia with gnathos beaklike; lateral arms developed; lower margin broadly rounded; apical part abruptly tapering to bluntly pointed apex; apex upturned and notched; outer (under) surface slightly roughened. Uncus with basal part ovoid, produced backward (cowlike), covered with short scobinations; apical part somewhat short in proportion to basal, tapering to pointed apex. Harpe with narrowed cucullus; apex bluntly rounded; sacculus produced into a very short spine at apex; basal projection of costa greatly produced. Anellus consisting of ventral plate and unsclerotized dorsal membrane; ventral plate with upper margin deeply angulate-emarginate, lateral margins widely and rather deeply concave. Aedeagus with apical half and extreme base greatly narrowed; apical half rodlike, curved at apex; manica prominent, but weakly sclerotized.

*Female*.—Wing color and venation as in the male. Anal tuft white.

Alar expanse, 25–30 mm.

Genitalia with genital plate large, completely surrounding genital opening, strongly sclerotized, its lateral areas granulate; lower margins of genital opening deeply rugose, black-brown and very strongly sclerotized; at caudal margin a short, hollow, outwardly projecting nipple.

*Type and paratypes*.—U.S.N.M. no. 51863. Paratypes also in British Museum.

*Type locality*.—Harris County, Tex. (May).

*Remarks*.—Described from male type, six male and six female paratypes; the paratypes distributed as follows: TEXAS, Harris County, one male and one female; GEORGIA, one male and one female; FLORIDA ("Allen River to Deep Lake", April 12, 1912), one male, Everglades, one female; ALABAMA, Selma (E. A. Schwarz, September 1880), one male; "STATEN ISLAND" ("26–VI–01"), one female; also two males and two females from the Zeller collection (1880) in the British Museum, without locality label but presumably from Texas.



The species as far as I know is limited to the United States. Hitherto specimens have been identified as *albinella* Cramer. It can be identified at once by its peculiar aedeagus and female genital plate.

**RUPELA SCITULA, new species**

**PLATE 26, FIGURES 15-15c**

*Male*.—Wings shining white. Fore wing with veins 11 and 12 separate; 4 and 5 approximate or connate. Hind wing with 4 and 5 stalked. Anal tuft white.

Alar expanse, 21-29 mm.

Genitalia with gnathos beaklike; lateral arms well developed; basal projecting part truncate; apical part tapering to pointed apex; inner surface sparsely and very finely scobinate. Uncus with basal part bilobed but rather small as compared with other species, the lobes bearing several short spines on dorsum; apical part long, tapering to pointed apex. Harpe with basal process of costa slightly produced; apex bluntly rounded; sacculus produced into a narrow, elongate fold at apex, otherwise simple. Anellus consisting of ventral plate and a partially sclerotized dorsal band, the latter bearing one pair of very long, stout spines and a pair of much thinner and shorter spines; lateral margins of ventral plate narrowly but deeply excurvate. Aedeagus with apex deeply but narrowly excavate on under side and bearing several short, stout, ventral spines. Tegumen with sharp, projecting spur (*Tgsp*) from each inner lateral margin.

*Type and paratype*.—U.S.N.M. no. 51864. Paratypes also in Cornell University collection and British Museum.

*Type locality*.—Tucuman, Argentina.

*Remarks*.—Described from male type and seven male paratypes, the paratypes distributed as follows: On boat from MEXICO (Quarantine no. Phila. 27764), one; BRAZIL, Obydos (E. E. Austin, February 2, 1896), one, Rio Janunda ("11-4-47"), two; BRITISH GUIANA, Mackenzie, Demerara (W. T. M. Forbes, June 23-24, 1927), three.

May be identified at once by the shape of the uncus, the spining of the dorsal part of the anellus, and the spurs on the tegumen.

Female unknown.

**RUPELA ADUNCA, new species**

**PLATE 27, FIGURES 16-16c**

*Male*.—Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 shortly stalked. Hind wing with 4 and 5 very shortly stalked. Anal tuft yellow.

Alar expanse, 39 mm.

Genitalia with gnathos bandlike, the central portion widely expanded (apronlike). Uncus with base enlarged, bulbous, covered with small, papillate protuberances and with a narrow dorsal groove; apical part laterally compressed (knifelike), slightly humped at middle; apex pointed. Harpe with basal projection from costa greatly produced and fusing with membranous, minutely scobinate transtilla; sacculus produced at apex into an upcurved sclerotized lip from which a sclerotized ridge extends upward to the costa; at center of ridge a slight projection. Anellus consisting of ventral plate and dorsal membrane; ventral plate with upper margin broadly and deeply angulate and lateral margins deeply excavate. Aedeagus heavy; basal part swollen; apex produced into a stout, blunt hook.

*Type*.—U.S.N.M. no. 51865.

*Type locality*.—Bolivia.

*Remarks*.—Described from one male from the National Museum collection labeled as follows: "17-46-55 S. Lat., 63-5-34 Long."

A large species easily identified by its peculiar aedeagus and uncus. Female unknown.

RUPELA LUMARIA, new species

PLATE 27, FIGURES 17-17c

*Male*.—Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 closely approximate. Hind wing with 4 and 5 closely approximate. Anal tuft yellow.

Alar expanse, 30 mm.

Genitalia with gnathos bandlike, slightly expanded at middle. Uncus with basal part a broadly triangular, hoodlike, rugose projection with deep central, dorsal groove; apical part abruptly tapering to pointed apex. Harpe with basal costal projection strongly produced and fusing with finely scobinate, membranous transtilla; sacculus produced into an elongately triangular, coarsely scobinate projection with apex sharply pointed; apex of harpe bluntly rounded. Anellus consisting of ventral plate and membranous dorsal part, the latter faintly rugose. Aedeagus stout, cylindrical; apex expanded and produced into three heavy claws.

*Type*.—U.S.N.M. no. 51866.

*Type locality*.—Carillo, Costa Rica (W. Schaus, March).

*Remarks*.—Described from single male. Can be identified by basal modification of uncus, the 3-clawed aedeagus, and the heavy, triangular, scobinate projection of the sacculus.

Female unknown.

## RUPELA HORRIDULA, new species

PLATE 27, FIGURES 18-18f; PLATE 33, FIGURE 47

*Male*.—Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 connate or closely approximate. Hind wings with 4 and 5 connate or shortly stalked. Anal tuft yellow.

Alar expanse, 22-32 mm.

Genitalia with gnathos bandlike, simple. Uncus with basal part bifid, produced as two subtriangular, laterally flattened, jagged lobes. Apical part smooth except for a slight dorsal keel near apex; apex hooked. Harpe broad; apex bluntly pointed; basal projection of costa considerably produced and fusing into membranous transstilla; sacculus produced at apex into a short, broad, blunt, up-curved spur; from this a sclerotized ridge extends to the basal projection of the costa. Anellus consisting of ventral plate and a pair of strongly sclerotized, narrow, sinuous, irregularly serrate dorsal plates; ventral plate with upper (caudal) margin deeply angulate and lateral margins excavate. Aedeagus with from one to three ventral thornlike teeth toward apex; penis bearing a small, flattened, serrate cornutus.

*Type and paratypes*.—U.S.N.M. no. 51867. Paratypes also in collections of Cornell University, British Museum and Harold E. Box.

*Type locality*.—Campo Bello, Rio de Janeiro, Brazil (Zikan, collector).

*Food plant*.—*Andropogon bicornis*. This food-plant record is from specimens submitted by Dr. H. E. Box, San José, British Guiana, April 1936 (Myers no. 5328).

*Remarks*.—Described from male type and 25 male paratypes, the paratypes distributed as follows: BRAZIL, Campo Bello (Rio de Janeiro), two, Organ Mountains (near Tijuca, Rio de Janeiro), one, Ponte Nova (Rio Xingu), three; SURINAM, Zanderij (Boven, Para District, April), one; FRENCH GUIANA, St. Jean Maroni, five; BRITISH GUIANA, San José (Pupununi District, April), two, Georgetown, one, Kartabo (Bartica District, October, November), four, Mackenzie (June), two, Rio Demerara, one; TRINIDAD, (Dyar collection, B. M. no. 1923-361), two, (Saunders collection, B. M. no. 94-68), one.

This species is easily recognized by the structure of its anellus and uncus. There is considerable variation in the size and spining of the basal lobes of the uncus in different specimens, but between the extreme forms (shown in pl. 27, figs. 18d and 18e) there is every possible intergrade so that no distinct varieties or races can be established.

Female unknown.

## RUPELA SPINIFERA, new species

## PLATE 28, FIGURES 19-19c

*Male*.—Wings shining white. Fore wing with veins 11 and 12 separate; 4 and 5 connate. Hind wing with 4 and 5 connate or shortly stalked. Anal tuft yellow.

Alar expanse, 39-45 mm.

Genitalia with gnathos bandlike, simple. Uncus with basal part produced backward into a broad, rounded, concave, and bifurcate plate armed along its outer margin with long, heavy spines; apical part long, its base clothed with long, slender hairs on dorsum, its apex sharply hooked. Harpe broad; cucullus abruptly narrowed; apex bluntly pointed; basal projection of costa long, digitate, fusing into membranous transtilla; sacculus produced at apex into a wide flange which is extended in a sclerotized ridge to basal projection of costa. Anellus consisting of ventral plate and dorsal membrane; upper margin of ventral plate angulate, lateral margins broadly excavate. Aedeagus long, tapering from slightly enlarged base to produced apex.

*Type*.—U.S.N.M. no. 51868. Paratype in British Museum.

*Type locality*.—Castro, Paraná, Brazil.

*Remarks*.—Described from male type (W. Schaus, collector) and one male paratype (E. D. Jones, collector) without dates and both from the type locality.

A large species distinguished by its long slender aedeagus and heavily spined uncus.

Female unknown.

## RUPELA MONSTRATA, new species

## PLATE 28, FIGURES 20-20c

*Male*.—Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 closely approximate. Hind wing with 4 and 5 closely approximate. Anal tuft yellow.

Alar expanse, 46 mm.

Genitalia with gnathos bandlike, simple. Uncus with base only slightly widened, produced backward into a stout, forked process with heavy, ribbed stem and thick, stubby prongs, the latter bearing one or two spines; apical part greatly extended, digitate; apex abruptly tapering and slightly hooked. Harpe broad; cucullus abruptly narrowed; apex bluntly pointed; basal projection of costa normally produced but not strongly sclerotized (transtilla membranous and not well defined); sacculus produced at apex into a shallow flange whose upper extremity is slightly notched. Anellus consisting of ventral plate and dorsal membrane; the upper and

lateral margins of the ventral plate are so deeply angulate that the upper half of the plate appears as two divergent bands. Aedeagus long; basal half slightly enlarged; apical half not appreciably tapering; apex truncate, with one or two short teeth at ventral extremity.

*Type*.—U.S.N.M. no. 51869.

*Type locality*.—Castro, Paraná, Brazil (W. Schaus).

*Remarks*.—Described from one male. The largest of the male *Rupelas*, easily identified by its anellus and greatly elongated digitate uncus.

Female unknown.

#### UNASSOCIATED FEMALES

##### RUPELA ANTONIA, new species

##### PLATE 30, FIGURE 31

Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 connate. Hind wing with 4 and 5 stalked. Anal tuft yellow.

Alar expanse, 38–43 mm.

Genitalia as in *leucatea* except that the lower margin of the genital opening is concave rather than sinuate and the sclerotization of the ductus bursae extends farther back from the genital opening.

*Type and paratype*.—U.S.N.M. no. 51892.

*Type locality*.—Sixola River, Costa Rica (April, September).

Described from two females, both from the type locality.

##### RUPELA BENDIS, new species

##### PLATE 29, FIGURE 21

Wings white. Fore wing with 11 and 12 separate; 4 and 5 connate or shortly stalked. Hind wing with 4 and 5 connate or shortly stalked. Anal tuft yellow.

Alar expanse, 28–33 mm.

Genitalia similar to those of *albinella* but without defined genital plate; area about genital opening very weakly sclerotized. Lower margin of genital opening concave and with a small notch in center.

*Type and paratype*.—U.S.N.M. no. 51893. Paratype also in British Museum.

*Type locality*.—Aroa, Venezuela.

*Remarks*.—Described from three females, the paratypes distributed as follows: VENEZUELA, Aroa, one; BRAZIL, Parapanema (Sao Paulo), one.

There are also two rather doubtful specimens in the British Museum from Brazil (Paraná de Buyassu and Rio Cararauca). In one of these the central notch in the lower margin of the genital opening is obsolete and in the other nearly so.

## RUPELA CANENS, new species

## PLATE 29, FIGURE 23

Wings white. Fore wing with veins 11 and 12 anastomosing; 4 and 5 connate. Hind wing with 4 and 5 shortly stalked. Anal tuft yellow. Alar expanse, 26–33 mm.

Genitalia similar to those of *bendis*, but area about genital opening more appreciably sclerotized; a genital plate faintly indicated. Lower margin of genital opening deeply concave (somewhat angulate). Bursa copulatrix very small, not reaching length of rods of eighth segment collar. Ductus bursae sclerotized for some distance from genital opening.

*Type*.—U.S.N.M. no. 51894. Paratype in British Museum.

*Type locality*.—Sao Paulo de Olivenca, Brazil.

*Remarks*.—Described from two females, the paratype from Parintins, Brazil.

In some characters the genitalia are more similar to those of *albinella* than to those of *bendis*. However, they seem to indicate a species distinct from either.

## RUPELA DRUSILLA, new species

## PLATE 29, FIGURE 24

Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 connate. Hind wing with 4 and 5 stalked. Anal tuft white.

Alar expanse, 28 mm.

Genitalia with genital opening wide. Genital plate reduced to area back of genital opening (not completely surrounding the opening), triangular. Lower margin of genital opening angulate. Ductus bursae laterally broadened and well sclerotized toward genital opening. The genitalia resemble most those of *segrega*, from which they are readily separated by the shape of the lower margin of the genital opening.

*Type*.—U.S.N.M. no. 51895.

*Type locality*.—Castro, Paraná, Brazil.

*Remarks*.—Described from one female. The fore wings of this specimen have a faint creamy tint, which may or may not be the normal color. I suspect that a series would show most of the specimens pure white. Possibly the female of *saetigera* or *pallidula*.

## RUPELA EDUSA, new species

## PLATE 30, FIGURE 29

Wings white. Fore wing with 11 and 12 separate or approximate; 4 and 5 separate or connate. Hind wing with 4 and 5 separate or connate. Anal tuft white.

Alar expanse, 21–26 mm.

Genitalia with area behind the genital opening markedly sclerotized and pigmented, smooth just behind opening and rugose and finely granulate beyond (in the direction of ovipositor). Lower margin of genital opening concave with lateral ends somewhat straightened; the ductus at genital opening narrowly sclerotized. Ductus seminalis from ductus bursae and forming a loop with it just before genital opening.

*Type and paratypes*.—U.S.N.M. no. 51896. Paratype also in British Museum.

*Type locality*.—Castro, Paraná, Brazil.

*Remarks*.—Described from seven females, the paratypes all from the type locality.

The species is chiefly distinguished by the peculiar shape and juncture of the ductus bursae and ductus seminalis. This may be the female of *labeosa*.

RUPELA FAUSTINA, new species

PLATE 29, FIGURE 22

Wings white. Fore wing with veins 11 and 12 anastomosing; 4 and 5 connate or shortly stalked. Hind wing with 4 and 5 connate or shortly stalked. Anal tuft yellow.

Alar expanse, 21–25 mm.

Genitalia with a smooth, sclerotized, roundly oval plate just behind genital opening. Lower margin of genital opening slightly angulate. Just within lip of genital opening a pair of short, dark, hooklike processes. Ductus weakly sclerotized toward genital opening.

*Type and paratype*.—U.S.N.M. no. 51897. Paratype also in British Museum.

*Type locality*.—Cabima, Panama (Busck, May).

*Remarks*.—Described from three females from the type locality.

From the fore-wing venation, size, and distribution I am inclined to believe that this is the female of *liberta*.

RUPELA GAIA, new species

PLATE 30, FIGURE 28

Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 closely approximate or connate. Hind wing with 4 and 5 closely approximate or connate. Anal tuft yellow.

Alar expanse, 39–48 mm.

Genitalia with area to the sides and behind the genital opening slightly rugose and weakly sclerotized. Lower margin of genital opening angulate. the angle bluntly pointed. Within the genital opening a pair of dark, small, oblong, sclerotized disks.

*Type and paratypes*.—U.S.N.M. no. 51898. Paratypes also in British Museum.

*Type locality*.—Castro, Paraná, Brazil.

*Remarks*.—Described from six females, the paratypes distributed as follows: BRAZIL, Castro, three; ARGENTINA, one; PARAGUAY, Villarrica (November), one.

RUPELA HERIE, new species

PLATE 30, FIGURE 27

White wings. Fore wing with veins 11 and 12 separate; 4 and 5 connate. Hind wing with 4 and 5 connate. Anal tuft yellow.

Alar expanse, 30–33 mm.

Genitalia with pigmented (yellow) and sclerotized genital plate; the plate rugose, especially toward margins and with caudal part acutely angulate. Genital opening semicircular, the lateral edges of its lower margin fusing into the plate.

*Type*.—U.S.N.M. no. 51899. Paratype in Cornell University collection.

*Type locality*.—Georgetown, British Guiana (April).

*Remarks*.—Described from two females, the paratype from Zanderij (Para District), Surinam (April).

RUPELA JANA, new species

PLATE 31, FIGURE 38

Wings white. Fore wing with veins 11 and 12 closely approximate (rarely anastomosing); 4 and 5 connate or shortly stalked. Hind wing with 4 and 5 connate or shortly stalked. Anal tuft yellow.

Alar expanse, 29–47 mm.

Genitalia with large sclerotized plate completely surrounding genital opening; its lateral areas partially detached from central portion of the plate; near its caudal margin a strongly sclerotized, brown, external pocket. Ductus unsclerotized at genital opening and the lower margin of genital opening unpigmented. Genital opening nearly circular.

*Type and paratypes*.—U.S.N.M. no. 51900. Paratypes also in British Museum and Cornell University collections.

*Type locality*.—Chaco, Argentina.

*Remarks*.—Described from 28 females, the paratypes distributed as follows: PANAMA, Porto Bello (May), four; SURINAM (no other locality, Zeller collection of British Museum), one; BRITISH GUIANA, Berbice, one; BRAZIL, Obydos (Pará), one, Rio Madeira, three, Rio Cuminae, one. Pará, two, Breves (January), one; PERU, Iquitos, one;



ARGENTINA, Villa Ana (January, February, March), eight, Goya, one, and two specimens without definite locality; PARAGUAY, Gran Chaco (March), one.

In addition to the type series there is one specimen in the British Museum from Sao Paulo, Brazil, that belongs here but is not included among the paratypes. It is abnormal, in that the sclerotized pocket is much narrower than in other specimens and the lateral areas of the genital plate are completely fused with the central area. The entire plate seems to have been pinched. I believe that these differences indicate nothing more than an individual and freak development.

**RUPELA CANDACE, new species**

**PLATE 29, FIGURES 25, 25a**

Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 closely approximate or connate. Hind wing with 4 and 5 connate. Anal tuft yellow.

Alar expanse, 38–44 mm.

Genitalia with large sclerotized plate surrounding genital opening; at its caudal end a strongly sclerotized, internal pocket (see projection sketch of pl. 29, fig. 25). Ductus sclerotized at genital opening. Margin of genital opening strongly sclerotized and dark brown. Genital opening oval.

*Type*.—In British Museum.

*Paratype*.—U.S.N.M. no. 51901.

*Type locality*.—Castro, Paraná, Brazil.

Described from two females from the type locality.

**RUPELA LARA, new species**

**PLATE 32, FIGURE 40**

Wings white. Fore wing with veins 11 and 12 approximate; 4 and 5 approximate or connate. Hind wing with 4 and 5 approximate, connate or stalked. Anal tuft yellow.

Alar expanse, 20–36 mm.

Genitalia with genital plate developed as a stout, blunt, thorn-like process just in front of genital opening. On each side of genital opening a large, finely scobinate, sclerotized area. Membrane back of genital opening unpigmented and unsclerotized except that in the area near eighth segment collar there is a small, brown, sclerotized, external pocket. Genital opening behind apex of genital plate. Ductus not appreciably sclerotized.

*Type and paratypes*.—U.S.N.M. no. 51902.

*Type locality*.—Cabima, Panama (May).

*Remarks.*—Described from three females, the paratypes distributed as follows: PANAMA, Rio Trinidad (June), one; COSTA RICA, Guapiles (March), one.

RUPELA MAENAS, new species

PLATE 31, FIGURES 36, 37

Wings white. Fore wing with veins 11 and 12 approximate; 4 and 5 closely approximate or connate. Hind wing with 4 and 5 connate or shortly stalked. Anal tuft yellow.

Alar expanse, 22–31 mm.

Genitalia with ductus bursae strongly sclerotized, brown and expanded into a laterally flattened bulb near genital opening. Genital plate developed as a narrow hoodlike piece in front and a broad, hooked, truncate flange behind genital opening (see pl. 31, fig. 36), the flange protruding from the area between the ventrolateral margins of the eighth segment collar. Genital opening nearly circular.

*Type and paratypes.*—U.S.N.M., no. 51903. Paratypes also in British Museum and Cornell University collections.

*Type locality.*—Ponte Nova (Rio Xingu), Brazil.

*Remarks.*—Described from eight females, the paratypes distributed as follows: FRENCH GUIANA, St. Laurent Maroni (March), one; BRITISH GUIANA, Kartabo (October), one, Mackenzie (June), two; SURINAM, Zanderij (April), two; BRAZIL, Castro (Paraná), one.

Easily identified by the bulbous, sclerotized ductus. I suspect it may be the female of *horridula*.

RUPELA NEREIS, new species

PLATE 31, FIGURES 33, 34

Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 connate. Hind wing with 4 and 5 connate. Anal tuft yellow.

Alar expanse, 40 mm.

Genitalia with ductus bursae brown, sclerotized and tubular toward genital opening. Genital plate consisting of a pair of narrow lateral flaps extending backward from margin of genital opening and fusing with a flanged and hooked process, which protrudes between the ventrolateral margins of the eighth segment collar; strongly sclerotized, brown; apex of protruding flange abruptly tapering to a blunt point. Ventral area between collar and ovipositor strongly sclerotized, developed as a pair of elongate, shallow, somewhat rugose depressions. Genital opening semicircular.

*Type.*—In British Museum.

*Type locality.*—Castro, Paraná, Brazil.

*Remarks.*—Described from one female.

Apparently nearest to *maenas* but not to be confused with anything in the genus.

RUPELA ORBONA, new species

PLATE 31, FIGURE 35

Wings white. Fore wing with veins 11 and 12 separate; 4 and 5 connate. Hind wing with 4 and 5 shortly stalked. Anal tuft yellow.

Alar expanse, 30 mm.

Genitalia with genital plate triangular, brown, sclerotized, appressed to and no wider than ductus bursae; in ductus (at end of genital plate) a pale yellow, round, rugose thickening of the tube. Area behind genital opening sclerotized and pigmented, a smooth angulate plate, at its apex a dark brown, heavily sclerotized, elongately triangular, internal pocket. Genital opening slitlike.

*Type*.—In Cornell University collection.

*Type locality*.—Mackenzie, British Guiana (June).

Described from one female.

RUPELA PROCULA, new species

PLATE 32, FIGURE 41

Wings white. Fore wing with veins 11 and 12 separate or approximate; 4 and 5 approximate. Hind wing with 4 and 5 approximate or connate. Anal tuft yellow.

Alar expanse, 50–51 mm.

Genitalia with genital plate surrounding the genital opening, irregular, strongly sclerotized and pigmented; from the area behind opening a deep, strongly sclerotized internal pocket; beyond this, the area between the ventrolateral margins of the eighth segment collar is rugose, partially pigmented, and sclerotized. Ductus strongly sclerotized, dark, and laterally expanded towards genital opening. Genital opening large, irregular.

*Type and paratype*.—U.S.N.M. no. 51904.

*Type locality*.—Sta. Catherina, Brazil.

Described from two females, the paratype from Jepelacio, Peru.

## EXPLANATION OF PLATES

The drawings for the plates accompanying this paper were made under the author's supervision by Mrs. Eleanor A. Carlin, of the Bureau of Entomology and Plant Quarantine. The female genitalia were drawn to smaller scale than those of the males.

### EXPLANATION OF SYMBOLS APPLIED TO GENITALIA

#### *Male*

- Cl*=Clasper of harpe.  
*Clh*=Basal projection from costa of harpe.  
*cn*=Cornutus (cornuti).  
*Cu*=Cucullus of harpe.  
*Gn*=Gnathos.  
*laGn*=Lateral arm of gnathos.  
*Ma*=Manica uniting anellus and aedeagus.  
*Sc*=Sacculus of harpe.  
*Tgsp*=Spur from ventrolateral margin of tegumen.  
*Tr*=Transtilla.  
*U*=Uncus.

#### *Female*

- Bc*=Bursa copulatrix.  
*Clr*=Collar of eighth abdominal segment.  
*Db*=Ductus bursae.  
*Ds*=Ductus seminalis.  
*Go*=Genital opening.  
*Gp*=Genital plate.  
*lm*=Lower margin of genital opening.  
*p*=Sclerotized pocket in area caudad of genital opening.

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### PLATE 22

- 1-1*d*. *Rupela leucatea* (Zeller): 1, Ventral view of male genitalia with aedeagus and one harpe omitted; 1*a*, anellus, dorsal view; 1*b*, aedeagus; 1*c*, lateral view of tegumen, uncus, and gnathos; 1*d*, dorsal view of uncus and gnathos.  
2-2*d*. *Rupela albinella* (Cramer): 2, Ventral view of male genitalia with aedeagus and one harpe omitted; 2*a*, anellus, dorsal view; 2*b*, ventral and lateral views of aedeagus (the lateral view showing anellus attached); 2*c*, lateral view of tegumen, uncus, and gnathos; 2*d*, dorsal view of uncus and gnathos.  
3-3*d*. *Rupela labeosa*, new species: 3, Ventral view of male genitalia with aedeagus and one harpe omitted; 3*a*, anellus, dorsal view; 3*b*, aedeagus; 3*c*, lateral view of tegumen, uncus, and gnathos; 3*d*, dorsolateral view of uncus and gnathos.

## PLATE 23

- 4-4c. *Rupela liberta*, new species: 4, Ventral view of male genitalia with aedeagus and one harpe omitted; 4a, dorsal view of anellus showing dorsal part and spines turned outward; 4b, dorsal view of anellus and spines in normal position; 4c, aedeagus.
- 5-5d. *Rupela pallidula*, new species: 5, Ventral view of male genitalia with aedeagus and one harpe omitted; 5a, anellus, dorsal view; 5b, aedeagus; 5c, lateral view of uncus and gnathos; 5d, dorsal view of uncus and gnathos.
- 6-6d. *Rupela segregata*, new species: 6, Ventral view of male genitalia with aedeagus and one harpe omitted; 6a, anellus, dorsal view; 6b, aedeagus; 6c, lateral view of uncus and gnathos; 6d, dorsolateral view of uncus and gnathos.

## PLATE 24

- 7-7d. *Rupela gibbera*, new species: 7, Ventral view of male genitalia with aedeagus and one harpe omitted; 7a, anellus, dorsal view; 7b, aedeagus with sclerotized manica; 7c, lateral view of uncus and gnathos; 7d, dorsal view of uncus and gnathos.
- 8-8c. *Rupela saetigera*, new species: 8, Ventral view of male genitalia with aedeagus and one harpe omitted; 8a, anellus, dorsal view; 8b, aedeagus with sclerotized manica; 8c, dorsal view of uncus and gnathos.
- 9-9c. *Rupela tinctella* (Walker): 9, Ventral view of male genitalia with aedeagus and one harpe omitted; 9a, anellus, dorsal view; 9b, aedeagus; 9c, lateral view of uncus and gnathos.

## PLATE 25

- 10-10c. *Rupela nivea* Walker: 10, Ventral view of male genitalia with aedeagus and one harpe omitted; 10a, anellus, dorsal view; 10b, aedeagus; 10c, lateral view of uncus and gnathos from abnormal specimen from Castro, Brazil.
- 11-11c. *Rupela vocativa*, new species: 11, Ventral view of male genitalia with aedeagus and one harpe omitted; 11a, anellus, dorsal view; 11b, aedeagus; 11c, dorsal view of uncus and gnathos.
- 12-12b. *Rupela cornigera*, new species: 12, Ventral view of male genitalia with aedeagus and one harpe omitted; 12a, anellus, dorsal view; 12b, aedeagus.

## PLATE 26

- 13-13c. *Rupela imitativa*, new species: 13, Ventral view of male genitalia with aedeagus and one harpe omitted; 13a, anellus, dorsal view; 13b, aedeagus; 13c, dorsal view of uncus and gnathos.
- 14-14c. *Rupela sejuncta*, new species: 14, Ventral view of male genitalia with aedeagus and one harpe omitted; 14a, anellus, dorsal view; 14b, aedeagus with attached manica; 14c, lateral view of uncus and gnathos.
- 15-15c. *Rupela scitula*, new species: 15, Ventral view of male genitalia with aedeagus and one harpe omitted; 15a, anellus, dorsal view; 15b, aedeagus; 15c, lateral view of tegumen, uncus, and gnathos.

## PLATE 27

- 16-16c. *Rupela adunca*, new species: 16, Ventral view of male genitalia with aedeagus and one harpe omitted; 16a, anellus, dorsal view; 16b, aedeagus; 16c, dorsal view of uncus and gnathos.
- 17-17c. *Rupela lumaria*, new species: 17, Ventral view of male genitalia with aedeagus and one harpe omitted; 17a, anellus, dorsal view; 17b, aedeagus; 17c, dorsal view of uncus and gnathos.
- 18-18f. *Rupela horridula*, new species: 18, Ventral view of male genitalia with aedeagus and one harpe omitted; 18a, anellus, dorsal view; 18b, aedeagus with anellus attached, lateral view; 18c, apex of aedeagus lateral view showing cornutus (cn) on penis; 18d, 18e, lateral views of uncus and gnathos in two specimens showing extremes of variation in the uncus; 18f, dorsal view of gnathos and uncus.

## PLATE 28

- 19-19c. *Rupela spinifera*, new species: 19, Ventral view of male genitalia with aedeagus and one harpe omitted; 19a, anellus, dorsal view, 19b, aedeagus; 19c, dorsal view of uncus and gnathos.
- 20-20c. *Rupela monstrata*, new species: 20, Ventral view of male genitalia with aedeagus and one harpe omitted; 20a, anellus, dorsal view; 20b, aedeagus; 20c, dorsal view of uncus and gnathos.

## PLATE 29

21. *Rupela bendis*, new species: Female genitalia.
22. *Rupela faustina*, new species: Female genitalia.
23. *Rupela canens*, new species: Female genitalia.
24. *Rupela drusilla*, new species: Female genitalia.
- 25, 25a. *Rupela candace*, new species: 25, Female genitalia, the projection to the side showing lateral view of genital opening, genital plate, and sclerotized pocket; 25a, dorsal view of collar of eighth abdominal segment.
- 26-26b. *Rupela albinella* (Cramer): 26, Female genitalia; 26a, lateral view of organs with bursa omitted; 26b, ventral view of genital plate and opening and eighth segment collar, from a specimen showing extreme of variation from normal specimens.

## PLATE 30

27. *Rupela herie*, new species: Female genitalia.
28. *Rupela gaia*, new species: Female genitalia.
29. *Rupela edusa*, new species: Female genitalia.
30. *Rupela leucatea* (Zeller): Female genitalia.
31. *Rupela antonia*, new species: Female genitalia.
32. *Rupela segregata*, new species: Female genitalia.

## PLATE 31

- 33, 34. *Rupela nereis*, new species: 33, Lateral view of femal genitalia; 34, ventral view.
35. *Rupela orbona*, new species: Female genitalia, the projection to the side showing lateral view of genital opening, genital plate, and sclerotized pocket.

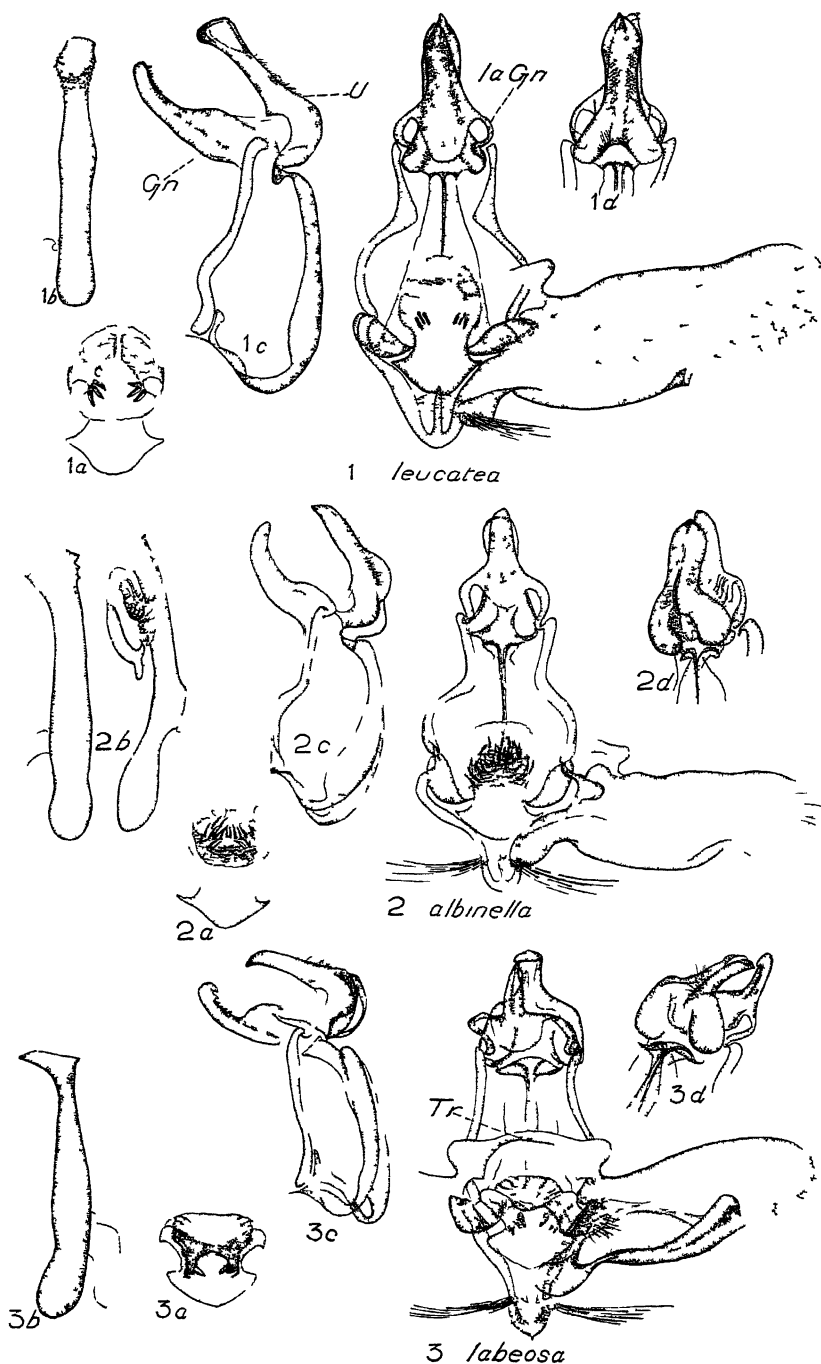
- 36, 37. *Rupela maenas*, new species: 36, Lateral view of female genitalia; 37, ventral view.  
38. *Rupela jana*, new species: Female genitalia.

## PLATE 32

39. *Rupela sejuncta*, new species: Female genitalia.  
40. *Rupela lara*, new species: Female genitalia.  
41. *Rupela procula*, new species: Female genitalia.  
42, 43. *Rupela tinctella* (Walker): 42, Lateral view of female genitalia; 43, ventral view.

## PLATE 33

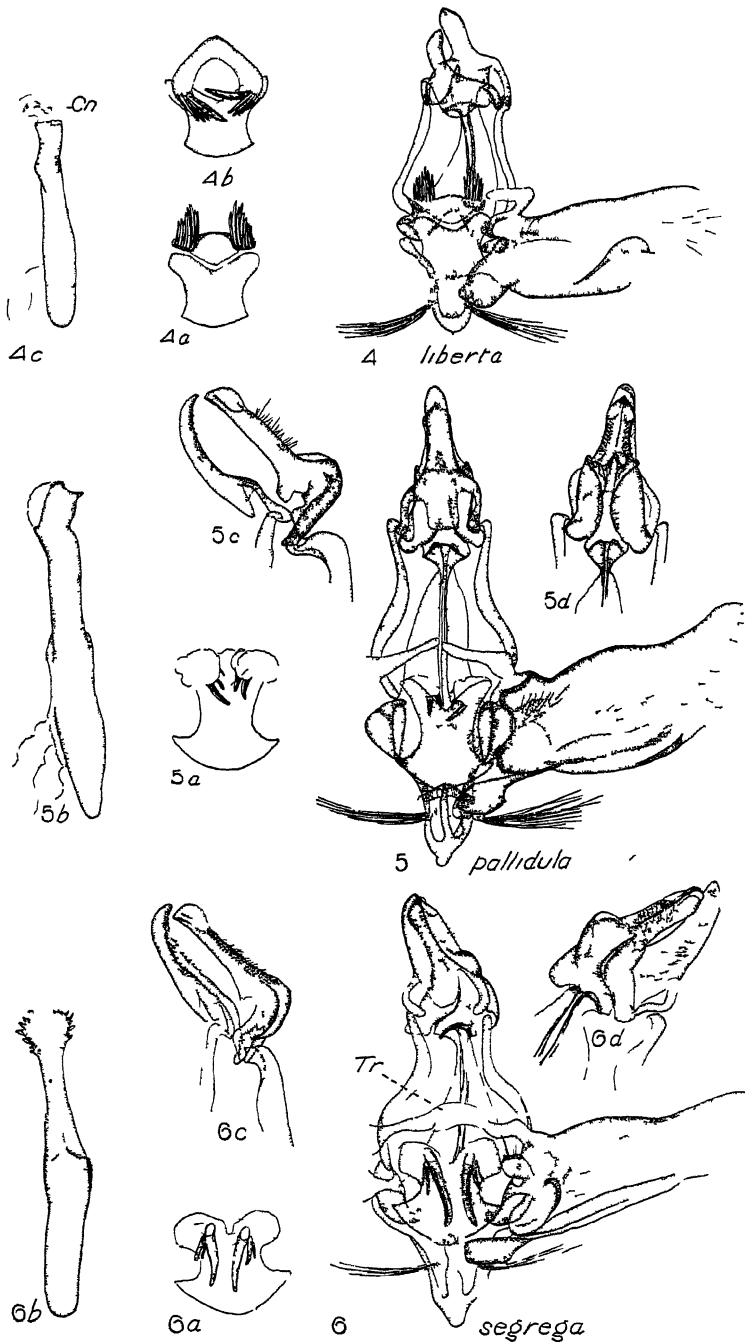
- 44, 45, 48. *Rupela leucatea* (Zeller): 44, Seventh abdominal segment of female, showing sclerotization of sternite; 45, ventral view of eighth abdominal segment of male and part of seventh, showing sclerotized plates and scale tuft; 48, side view of head and expanded thoracic hair tuft.  
46. *Rupela tinctella* (Walker): Seventh abdominal segment of female, ventral view, showing sclerotization.  
47. *Rupela horridula*, new species: Venation of fore and hind wings.



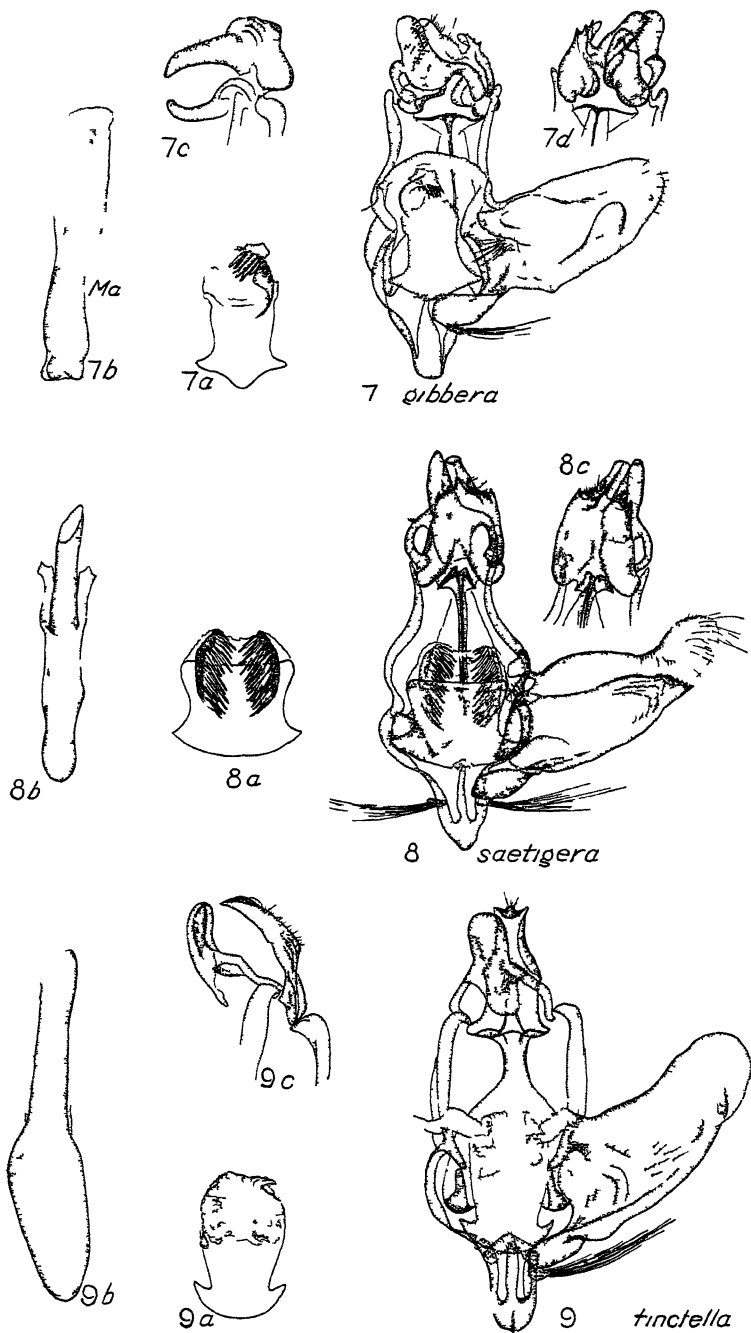
MOTHS OF GENUS RUPELA MALE GENITALIA.

FOR EXPLANATION OF PLATE SEE PAGE 385.



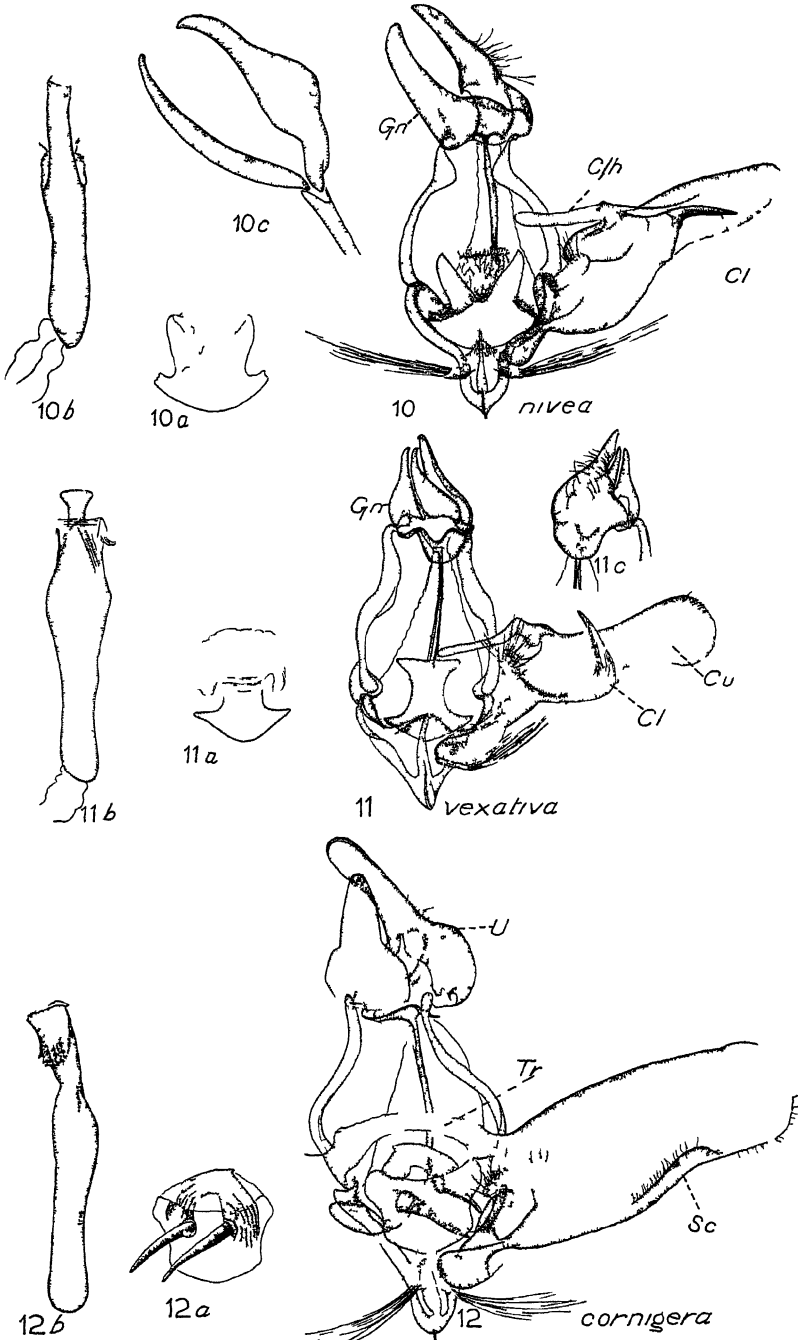


MOTHS OF GENUS RUPELA MALE GENITALIA  
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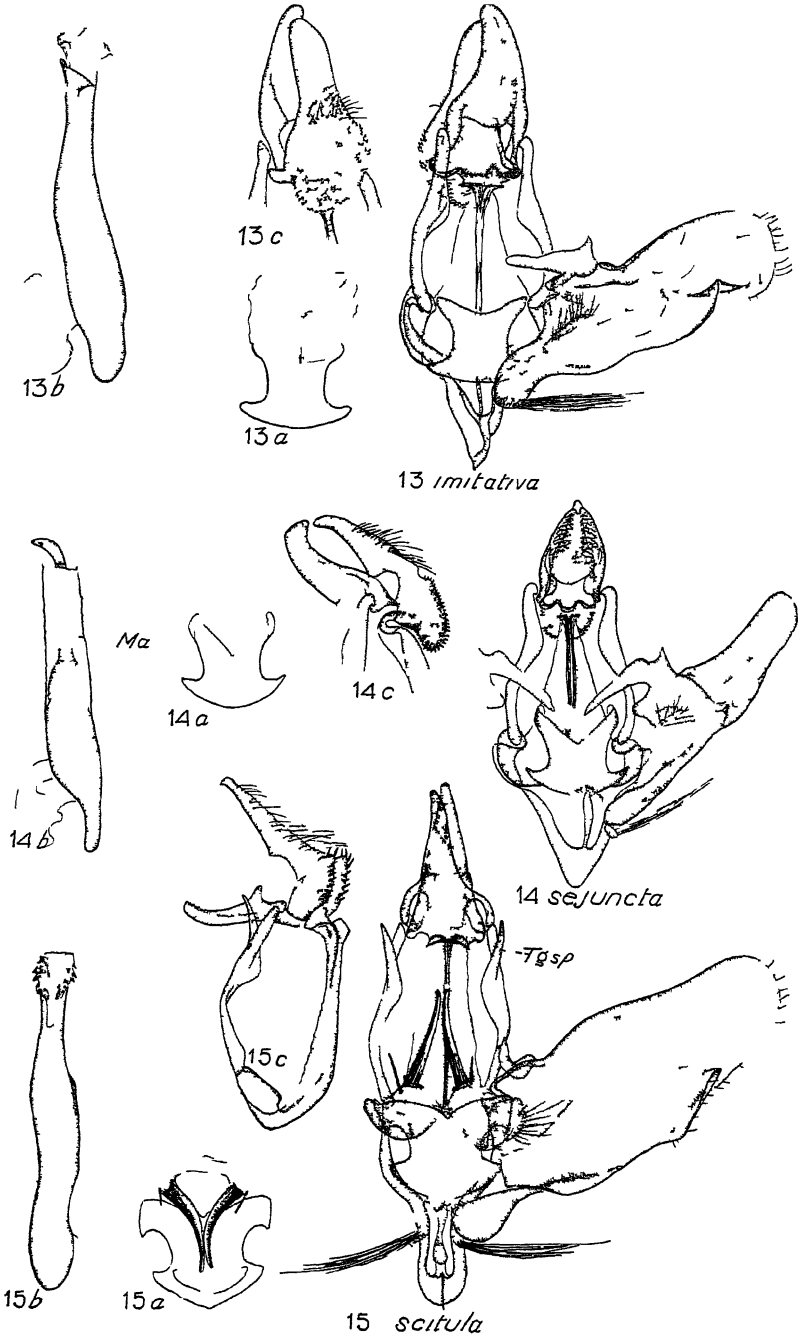
MOths OF GENUS RUPELA MALE GENITALIA

FOR EXPLANATION OF PLATE SEE PAGE 386

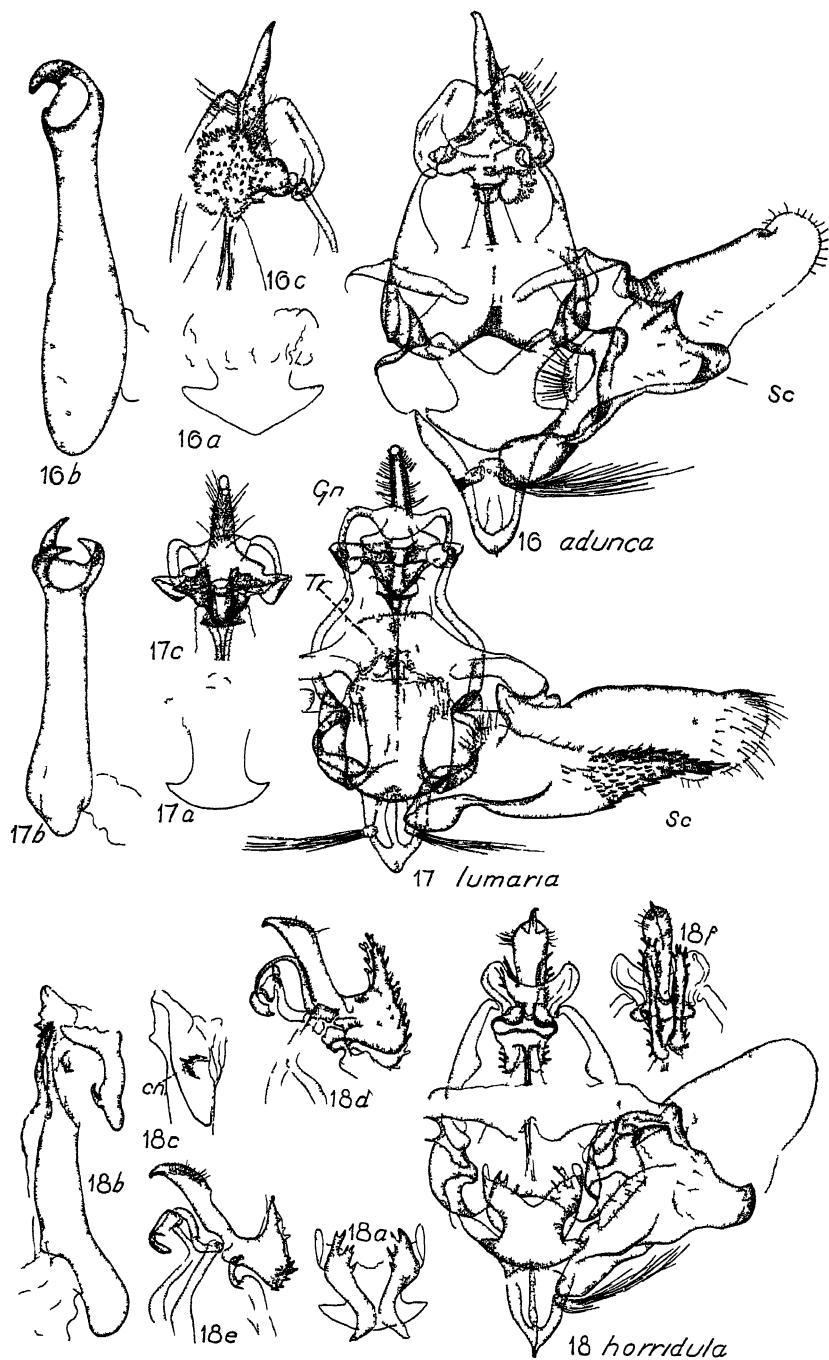


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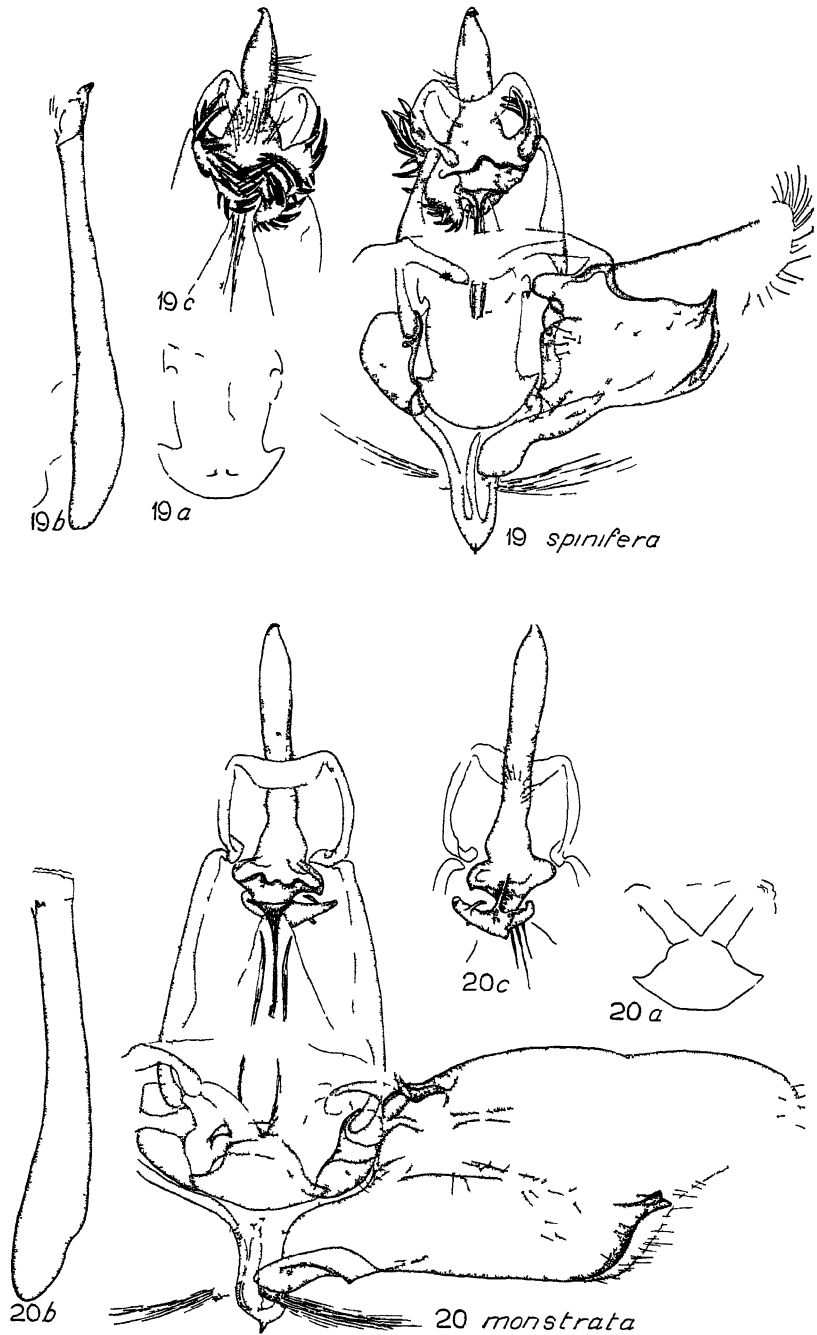
FOR EXPLANATION OF PLATE SEE PAGE 388.



MOTHS OF GENUS RUPELA MALE GENITALIA  
FOR EXPLANATION OF PLATE SEE PAGE 96

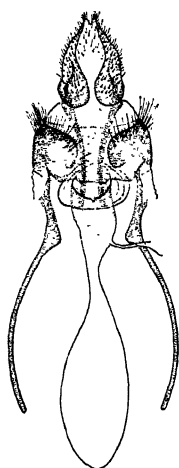
MOTHS OF GENUS *RUPELA* MALE GENITALIA

FOR EXPLANATION OF PLATE SEE PAGE 387

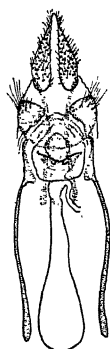


MOths OF GENUS RUPELA MALE GENITALIA

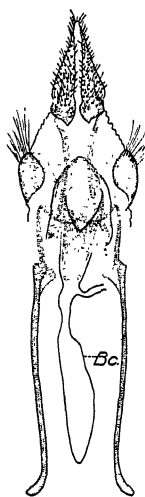
FOR EXPLANATION OF PLATE SEE PAGE 387



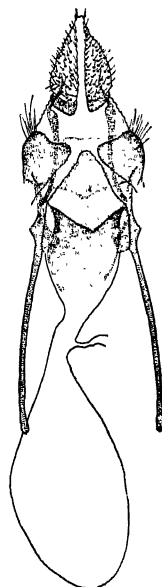
21 *bendis*



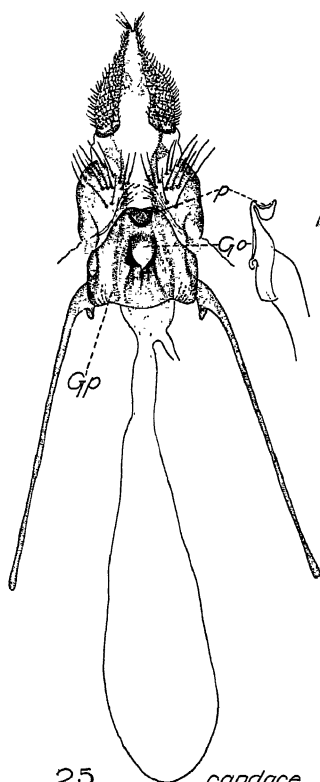
22 *faustina*



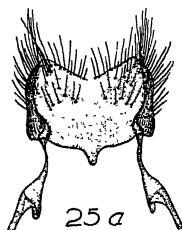
23 *canens*



24 *drusilla*



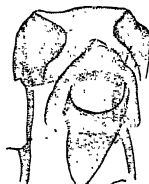
25 *candace*



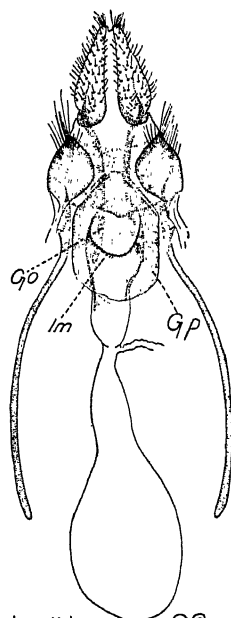
25 a



26 a



26 b

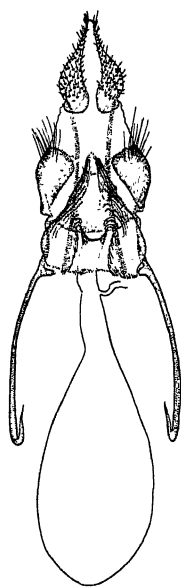


*albinella*

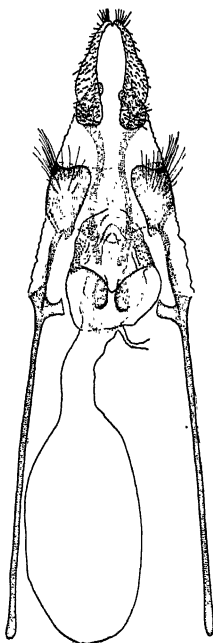
26

MOths OF GENUS RUPELA: FEMALE GENITALIA.

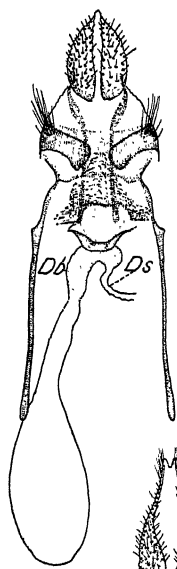
FOR EXPLANATION OF PLATE SEE PAGE 387.



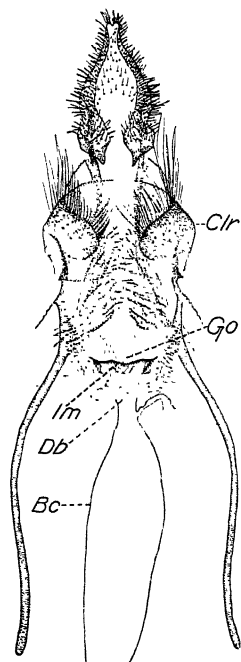
27 *herie*



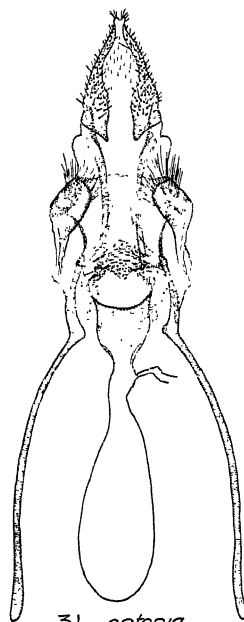
28 *gaia*



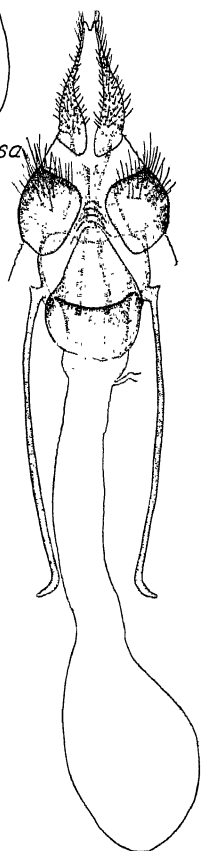
29 *edusa*



30 *leucatea*



31 *antonia*



32 *segregata*

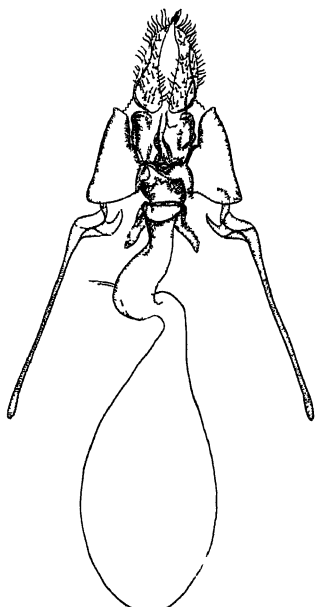
MOTHS OF GENUS RUPELA: FEMALE GENITALIA.

FOR EXPLANATION OF PLATE SEE PAGE 387.

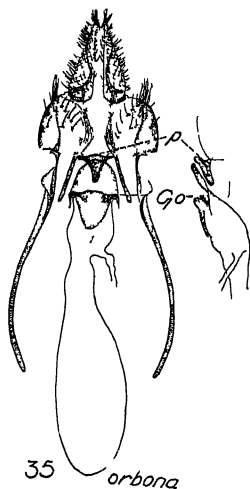




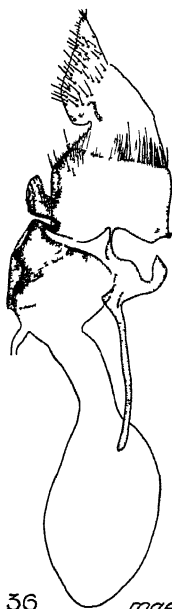
33 *nerei*



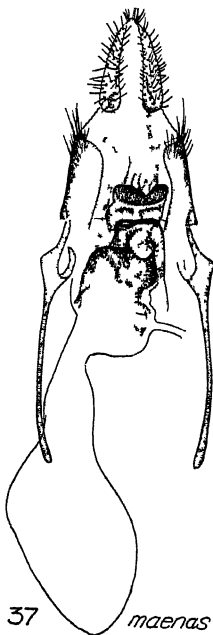
34 *nerei*



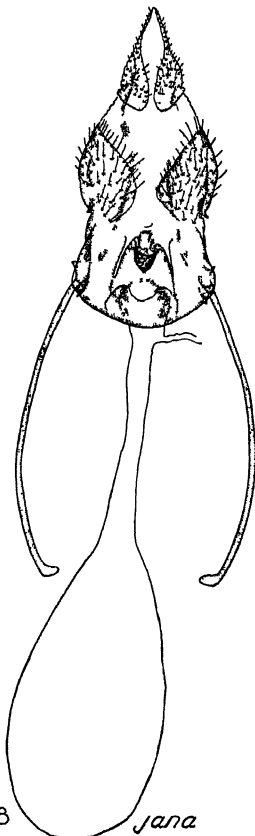
35 *orbona*



36 *maenas*



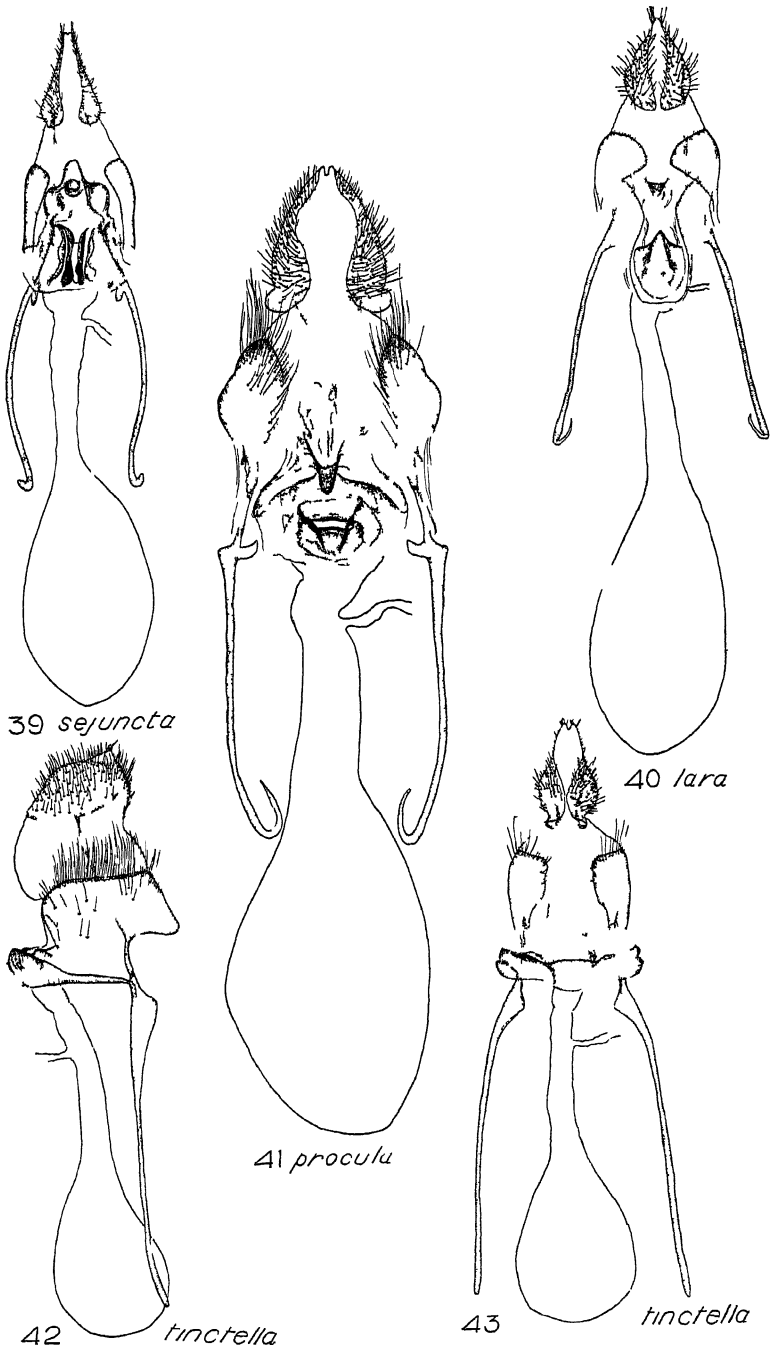
37 *maenas*



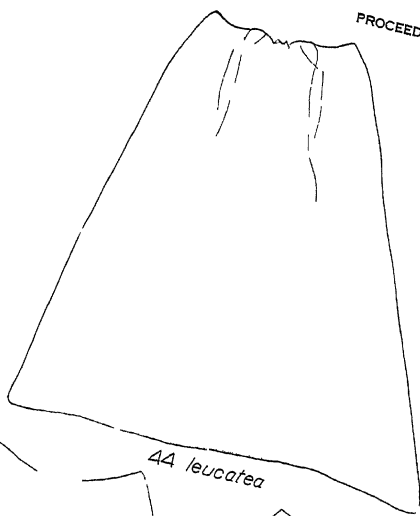
38 *jana*

MOTHS OF GENUS RUPEIA FEMALE GENITALIA

FOR EXPLANATION OF PLATE SEE PAGES 387-388



MOTHS OF GENUS RUPELA FEMALE GENITALIA  
FOR EXPLANATION OF PLATE SEE PAGE 388



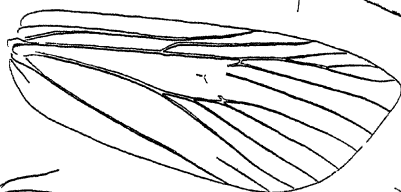
44 *leucatea*



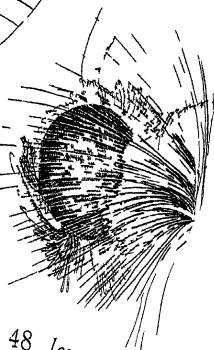
45 *leucatea*



46 *tinctella*



47 *horridula*



48 *leucatea*







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U. S. NATIONAL MUSEUM

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No. 3020

SYNOPSIS OF THE PUERTO RICAN BEETLES OF THE  
GENUS MORDELLISTENA, WITH DESCRIPTIONS OF  
NEW SPECIES <sup>1</sup>

By EUGENE RAY

THE specimens of mordellid beetles treated herein were received for study from the United States National Museum and Prof. S. T. Danforth, of the University of Puerto Rico. All the types of new species, including those sent by Professor Danforth, are now deposited in the National Museum.

Four species of the genus *Mordellistena* were previously known from the island of Puerto Rico. Ten new species are added in this paper. These may be separated by use of the accompanying key. The short subapical ridge on the posterior tibiae is omitted in the notes and descriptions.

Genus MORDELLISTENA Costa

*Mordellistena* COSTA, Fauna del regno di Napoli. . . , Coleoptera, vol. 1, Mordellidae, p. 16, 1853.

KEY TO THE PUERTO RICAN SPECIES OF MORDELLISTENA

- |   |   |
|---|---|
| 1. Basal ridge of hind tibiae extending halfway across outer surface<br>(fig. 28, b)----- | 2 |
| Basal ridge of hind tibiae extending entirely across outer surface<br>(fig. 28, c)-----   | 9 |
| 2. Derm of head and thorax unicolorous-----   | 3 |
| Derm of head and thorax bicolorous-----   | 5 |

<sup>1</sup> Contribution from the Entomological Laboratories of the University of Illinois, no 182

3. Ventral surface, including legs, entirely unicolorous; total length not more than 2.5 mm..... 4
- Ventral surface bicolorous, abdomen annulate with alternate castaneous and fuscous bands..... *annuliventris* Quedenfeldt
4. Five basal segments of antennae flavous, rest black; head, thorax, and ventral thoracic segments piceous. *angustiformis*, new species
- Entire body surface flavous..... *ferruginea* (Fabricius)
5. Distal segment of maxillary palpi triangular (fig. 28, *d-f*)..... 6
- Distal segment of maxillary palpi club-shaped (fig. 28, *g*).  
*varietas*, new species
6. Hind basitarsus with three oblique ridges (fig. 28, *c*)..... 7
- Hind basitarsus with two oblique ridges (fig. 28, *b*).  
*signaticollis* Quedenfeldt
7. Elytra less than three times as long as broad..... 8
- Elytra more than three times as long as broad..... *marginicollis* Mäklin
8. Antennal segments 3 and 4 equal in length, segments 4 and 11 black, extreme apices ridged with flavous..... *danforthi*, new species
- Antennal segment 4 distinctly longer than 3, segments 4-11 entirely fuscous..... *humeralis*, new species
9. Second segment of hind tarsus with one ridge (fig. 28, *b*)..... 10
- Second segment of hind tarsus with two ridges (fig. 28, *c*)..... 11
10. Segments 5-10 of antennae each as long as 3 and 4 together, segment 11 one-fourth longer than 10..... *lineata*, new species
- Segments 5-10 of antennae each no longer than 4 alone, segment 11 almost twice as long as 10..... *barberi*, new species
11. Anterior tibiae slender..... 12
- Anterior tibiae with a knifelike form (fig. 28, *h*)..... *leai*, new species
12. Base of elytra with a Y-shaped spot surrounding scutellum (fig. 28, *i*); elytra almost three times as long as broad... *y-nigrum*, new species
- Elytra lacking Y-shaped scutellar spot; elytra less than two and one-half times as long as broad..... 13
13. Distal segment of maxillary palpus with concave outer margin; basitarsus of hind legs with two oblique ridges (fig. 28, *b*).  
*lucidovirga*, new species
- Distal segment of maxillary palpus with straight outer margin (fig. 28, *e*); basitarsus of hind legs with three oblique ridges (fig. 28, *c*)..... *ephippium*, new species

**MORDELLISTENA ANNULIVENTRIS** Quedenfeldt

*Mordellistena annuliventris* QUEDENFELDT, Berliner Ent. Zeitschr., vol. 30, p. 126, 1886.

One specimen: Aibonito, Puerto Rico, July 23, 1934 (R. G. Oakley).

**MORDELLISTENA ANGUSTIFORMIS**, new species

FIGURE 28, *b*

This species may be separated from *signaticollis* Quedenfeldt (1886, p. 125) by the black derm of the head and thorax, the absence of a black marginal line on the elytra, and the single oblique ridge on the second segment of hind tarsi.

Length: 1.85 mm; including anal style, 2.45 mm. Elongate, subparallel. Derm generally black; elytra castaneous with a narrow,

piceous, sutural line; anterior and middle legs and hind tibiae and tarsi flavous; basal five segments of antennae and maxillary palpi flavous. Body densely covered with fine, recumbent, flavocinereous pubescence.

Antennae 0.5 mm long, reaching posterior coxae; segment 4 one-half longer and distinctly broader than 3; 5–10 each as long as 4 and slightly broader; 11 rounded, slightly longer than 10. Apical segment of maxillary palpus enlarged, triangular, sides straight, corners rounded. Prothorax broader than long (0.65 by 0.5 mm), sides rounded, base arcuate, midbasal lobe short, rounded. Scutellum small, triangular. Elytra slightly more than twice as long as broad (1.35 by 0.65 mm), sides subparallel, apices individually rounded. Posterior tibiae with two equal oblique ridges extending halfway across outer face; posterior basitarsus with two oblique ridges, second segment with one oblique ridge. Anal style but twice as long as apical ventral segment, stout, evenly attenuate, truncate at apex.

*Type locality*.—Yauco, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51597.

*Remarks*.—The type was collected at Yauco on June 15, 1934 (C. M. Matos); the allotype was collected at Adjuntas on June 1, 1934 (R. G. Oakley). There is no visible external difference between the sexes.

#### MORDELLISTENA FERRUGINEA (Fabricius)

*Mordella ferruginea* FABRICIUS, *Systema eleutheratorum*. . . vol. 2, p. 124, 1801.  
*Mordellistena ferruginea* QUEDENFELDT, *Berliner Ent. Zeitschr.*, vol. 30, p. 127, 1886.

Eleven specimens: Two from Aibonito, June 8, 1934 (C. M. Matos); seven from Juana Diaz, April 10, 1933, on *Inga laurina* (R. G. Oakley); one from Ponce, January 3, 1933, on leaf of banana (R. G. Oakley); one from Barceloneta, April 25, 1933 (R. G. Oakley).

#### MORDELLISTENA VARIETAS, new species

FIGURE 28, *g, k*

From *signaticollis* Quedenfeldt (1886, p. 125) this species may easily be separated by the black color of the elytra and the different shape of the distal segment of the maxillary palpus.

Length: 2.8 mm; including anal style, 3.9 mm. Elongate-oval, sides narrowly rounded; head flavous, vertex with a rounded fuscous spot almost reaching eyes and occiput; pronotum flavous with a median fuscopiceous stripe, broadest at base and embracing the entire midbasal lobe; antennae flavous at base, piceous at apex, intermediate segments successively darker toward distal end; sternal sclerites of thorax and elytra wholly piceous; maxillary palpi, legs, and ventral abdominal segments castaneous. Body densely covered with fine recumbent pubescence, generally partaking of ground color.



Antennae 0.85 mm long, reaching base of metasternum; segment 4 one-half longer than 3; 5-10 each as long as 4 and slightly broader; 11 rounded, no longer than 10. Apical segment of maxillary palpi enlarged, club-shaped, broadest subapically, then rounded to distal end. Pronotum but slightly broader than long (0.75 by 0.7 mm), convex, sides margined, basal angles obtuse, midbasal lobe broad, rounded. Scutellum small, triangular. Elytra almost two and one-half times as long as broad (2.1 by 0.8 mm), sides distinctly rounded, apices individually curved. Posterior tibiae with two oblique equal ridges extending halfway across outer face; posterior basitarsi with three oblique ridges, basal one rudimentary, second segment with two such ridges. Anal style almost three times as long as apical ventral segment, rather thick and truncate at apex.

*Type locality*.—Adjuntas, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51598.

*Remarks*.—The type was collected at Adjuntas on March 24, 1933, on orange leaf (R. G. Oakley); the allotype was collected at Villalba on June 21, 1934 (C. M. Matos); a male paratype was collected at Maricao on July 2, 1917 (H. Morrison). No visible external differences in the sexes were noted.

MORDELLISTENA DANFORTH, new species

FIGURE 28, i

This species may be separated from *indistincta* Smith (1882, p. 93) by the bicolorous antennae and ventral abdominal segments and by the broader distal segment of the maxillary palpi.

Length: 2.4 (male) and 2.3 (female) mm; including anal style 3.5 (male) and 3.2 (female) mm. Elongate, subparallel; dermal color flavous, except for the following fuscous areas: Eyes, seven apical segments of antennae, scutellum, elytra (except a broad, light, humeral spot extending along base to suture), three apical ventral abdominal segments (except at apex), apical two-thirds of anal style, and ridges and apical setae of hind tibiae and tarsi. Surface densely covered with fine recumbent pubescence, partaking of ground color, except on fuscous portion of elytra, where it is golden.

Antennae 1 mm long, reaching base of abdomen; segments 3 and 4 equal; 5-10 each one-third longer and slightly broader than 4; 11 rounded, slightly longer than 10; apical segment of maxillary palpi enlarged, elongate-triangular. Prothorax slightly wider than long (0.75 by 0.7 mm), sides rounded, base arcuate, midbasal lobe short, rounded. Scutellum small, subtriangular. Elytra slightly more than twice as long as broad (1.7 by 0.8 mm), sides parallel, apices rounded. Hind tibiae with two oblique ridges extending halfway across outer face; basitarsi with three, second segment with two

oblique ridges. Anal style almost three times as long as apical ventral segment, attenuate to apex.

The abdominal segments of the female (except anal style) lack the fuscous coloration of the male, and the general castaneous color is lighter. The prothorax and the elytra are narrower than in the male.

*Type locality*.—Villalba, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51599.

*Remarks*.—Both the type and allotype were collected at Villalba on June 21, 1934, by C. M. Matos. This species is dedicated to Prof. S. T. Danforth for his kindness in permitting the writer to study his collection of Puerto Rican Mordellidae.

MORDELLISTENA HUMERALIS, new species

FIGURE 28, a

This species may be separated from its closest ally *militaris* LeConte (1862, p. 49), by the bicolored antennae and ventral abdominal segments and by the broader terminal segment of the maxillary palpi.

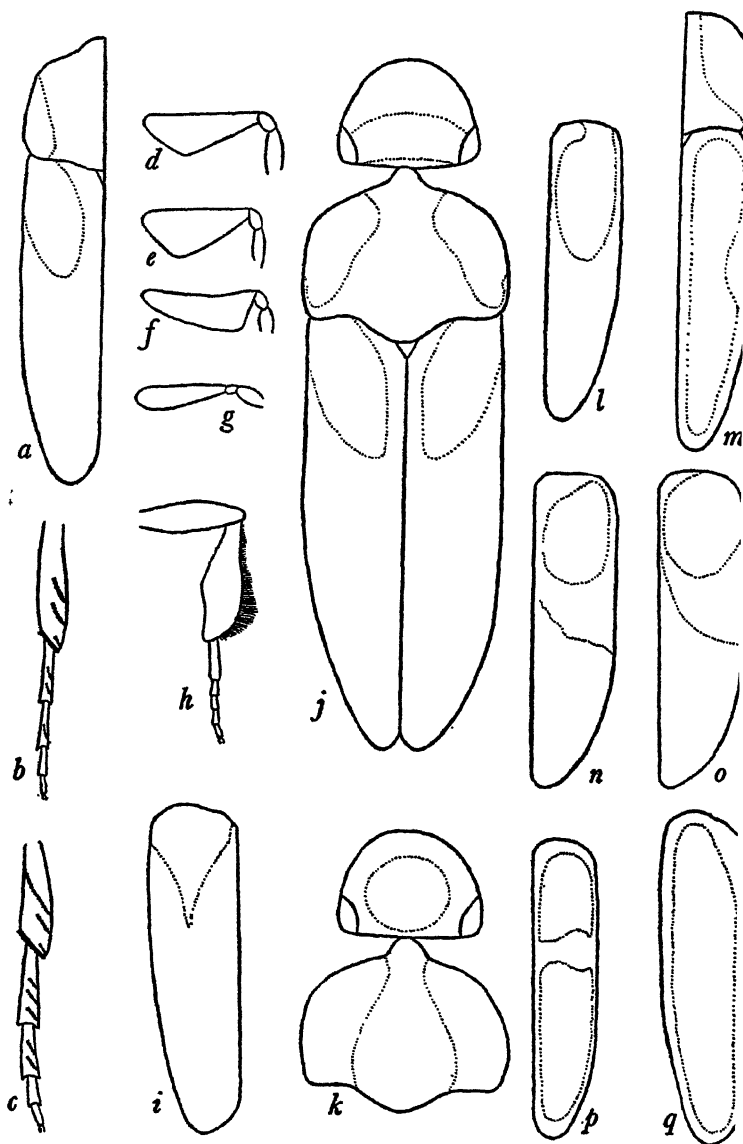
Length: 2.6 mm; including anal style, 3.8 mm. Elongate, subparallel; derm generally black, with the following exceptions: Clypeus and front narrowly, humeri of elytra broadly, inner edge of this spot diagonal, almost reaching suture, extending nearly one-half entire length, flavocastaneous; antennae with three basal segments and extreme apex of succeeding segments, maxillary palpi, and legs, flavous; medioanterior part of metasternum, basal abdominal segment wholly, and apical margins of succeeding segments, piceocastaneous. Body densely covered with fine recumbent pubescence, cinereous dorsally, whitish ventrally.

Antennae 0.6 mm long, reaching base of abdomen; segment 4 one-third longer than 3; 5-10 each as long as 3 and 4 combined and each broader; 11 rounded, but little broader than 10. Terminal segment of maxillary palpi enlarged, broadly triangular. Pronotum but slightly broader than long (0.75 by 0.67 mm), convex, sides finely margined, basal angles obtuse, midbasal lobe rounded, one-third width of pronotum. Scutellum small, subtriangular. Elytra almost two and one-half times as long as broad (1.95 by 0.8 mm), sides parallel for four-fifths their length, then rounded to suture. Hind tibiae with two oblique, equal ridges extending halfway across outer face; basitarsi with three, second segment with two ridges. Anal style two and two-thirds as long as apical ventral segment, attenuate to apex.

*Type locality*.—Villalba, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51600.

*Remarks*.—The single specimen at hand was collected at Villalba on June 21, 1934, by C. M. Matos.

FIGURE 28.—New species of *Mordellistena*

- a. *M. humeralis*: Right side.  
 b. *M. angustiformis*: Hind tibia and tarsus.  
 c, e, p. *M. ephippium*: c, Hind tibia and tarsus; e, maxillary palpus; p, elytron.  
 d, n, o. *M. barberi*: d, Maxillary palpus; n, elytron of female; o, elytron of male.  
 f, m. *M. lucidovirga*: f, Maxillary palpus; m, right side.  
 g, k. *M. varietas*: g, Maxillary palpus; k, dorsal view of head and pronotum.  
 h, j. *M. lei*: h, Anterior leg; j, dorsal view.  
 i. *M. danforthi*: Elytron.  
 l. *M. y-nigrum*: Elytron.  
 q. *M. lineata*: Elytron.

## MORDELLISTENA LINEATA, new species

FIGURE 28, *q*

This species is most closely allied to the North American *ancilla* LeConte (1862, p. 50), which it resembles in coloration; it may immediately be separated by its larger size and the smaller number of ridges on the posterior tarsi.

Length: 2.1 mm; including anal style, 2.9 mm. Elongate, subparallel; dermal color black, except for the following flavocastaneous areas: Front of head, maxillary palpi, seven apical segments of antennae, a broad median stripe on elytra, reaching base at humeri and extending to apex, anterior and middle legs, and hind trochanters, tibiae, and tarsi. Surface densely covered with recumbent pubescence, silvery everywhere, except on flavocastaneous areas, where it partakes of ground color.

Head convex; antennae 0.8 mm long, reaching base of abdomen; segments 3 and 4 equal; 5–10 each as long as 3 and 4 together; 11 rounded, one-fourth longer than 10. Apical segment of maxillary palpi enlarged, form of an isosceles triangle. Prothorax slightly broader than long (0.65 by 0.6 mm), sides rounded, base arcuate, mid-basal lobe short, subtruncate. Scutellum small, triangular. Elytra slightly more than twice as long as broad (1.5 by 0.7 mm), sides slightly curved, apices individually rounded. Posterior tibiae with two oblique ridges, the basal one extending entirely across outer face, the other as long as half width of tibia; basitarsi with two oblique ridges, second segment with one. Anal style almost three times as long as apical ventral segment, attenuate to apex.

*Type locality*.—Guanica, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51601.

*Remarks*.—Both the type and allotype were collected at Guanica on June 26, 1934, by C. M. Matos. There is no visible external difference in the sexes.

## MORDELLISTENA BARBERI, new species

FIGURE 28, *d, n, o*

This species may be separated from its closest ally, *lineata*, by the comparatively longer length of antennal segments 3 and 4, the different maculation of the elytra, and the smaller size.

Length: 1.65 mm; including anal style, 2.3 mm. Elongate, subparallel; derm bicolored, mostly yellowish white, except for the following fuscopiceous areas: Sides of mesosterna and metasterna, an area on elytra surrounding scutellum, and a transverse, premedian, elytral fascia, broadened at sides, and narrowly extending along suture to basal area. Surface densely covered with fine recumbent pubescence, partaking of ground color.

Antennae 0.5 mm long, reaching metasternum; segments 3 and 4 equal; 5-10 each slightly broader but no longer than 4; 11 rounded, almost twice as long as 10. Apical segment of maxillary palpi enlarged, form of an elongate scalene triangle, sides straight, corners rounded. Pronotum slightly broader than long (0.5 by 0.45 mm), convex, sides finely margined, basal angles obtuse, midbasal lobe distinct, broadly rounded. Scutellum small, triangular, broader than long. Elytra twice as long as broad (1.2 by 0.6 mm), sides gently curved, apices individually rounded. Posterior tibiae with two oblique ridges, the basal extending entirely across outer face; basitarsi with two oblique ridges, second segment with one oblique ridge, all extending halfway across outer surface. Anal style more than two and one-half times as long as apical ventral segment, slender, truncate at apex.

The female has the pronotum entirely black. The scutellar area of the elytra is more extensive than in the male, reaching the lateral margins, and the black sutural line is somewhat broader.

*Type locality*.—Ponce, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51602.

*Remarks*.—The type and allotype were taken at Ponce on April 29, 1933, on leaf of "moca" by R. G. Oakley; a female paratype was taken at Juana Diaz on February 23, 1933, on coffee leaf by R. G. Oakley. Here occurs one of the most striking cases of sexual dimorphism noted in the Mordellidae, the difference in color at once enabling an observer to separate the sexes.

This species is dedicated to H. S. Barber, for his kindness in arranging for the transmittal of specimens described herein and for other favors. The pin label of the type in Mr. Barber's handwriting indicates its undescribed condition.

MORDELLISTENA LEAL, new species

FIGURE 28, h, j

The expanded condition of the anterior tibiae in this species adequately separates it from any other known member of the genus. Superficially it resembles *signaticollis* Quedenfeldt (1886, p. 125) and *marginicollis* Mäklin (1875, p. 590).

Length: 2.4 mm; including anal style, 3.6 mm. Elongate, sub-parallel; derm black, except for the following flavous areas: Anterior part of head from a point beginning midway between eyes, and a narrow transverse line at base, sides of pronotum (broadest at anterior angles), a humeral spot on elytra extending one-third entire length and touching neither suture nor margins; antennae with four basal segments flavous, remainder fuscous, maxillary palpi and legs flavous (except hind femora). Surface densely covered with fine, short, recumbent pubescence, generally yellowish in color.

Antennae 1 mm long, reaching base of abdomen; segments 3 and 4 short, equal; 5-10 each slightly broader and as long as 3 and 4 together; 11 rounded, slightly longer than 10. Apical segment of maxillary palpi enlarged, with the form of an isosceles triangle, rounded at corners. Prothorax slightly broader than long (0.65 by 0.6 mm), sides rounded, base arcuate, midbasal lobe short, but evenly rounded. Scutellum small, triangular. Elytra two and one-half times as long as broad (1.8 by 0.7 mm), sides gently acuminate, apices individually rounded. Anterior tibiae enlarged, flattened, somewhat knifelike, dorsal edge fringed with fine, flexible hairs; posterior tibiae with two ridges, the anterior extending entirely across outer face; basitarsi and second segment each with two ridges, extending halfway across outer surface. Anal style more than three times as long as apical ventral segment, slender, attenuate to apex.

*Type locality*.—Bayamon, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51603.

*Remarks*.—The type was collected at Bayamon on April 26, 1934, by "Lesne et al."; a male paratype was collected at Maricao on July 2, 1917, by H. Morrison.

**MORDELLISTENA Y-NIGRUM, new species**

FIGURE 28, 1

The Y-shaped black spot on the region of the elytra surrounding the scutellum adequately separates this species from other allied forms. In a systematic arrangement it should be placed between *leai* and *lucidovirga*.

Length: 2.25 mm; including anal style, 3.1 mm. Elongate, subparallel; derm black, except for the following castaneous areas: Clypeus, basal half of elytra (enclosing a Y-shaped black spot surrounding scutellum and extending posteriorly on suture to middle), basal abdominal segment wholly, the remaining ventral segments along ventral margins, posterior legs, four basal segments of antennae; maxillary palpi and two anterior pairs of legs, whitish. Surface densely covered with fine recumbent pubescence, partaking of ground color, except on black areas, where it is golden.

Antennae 1 mm long, slender, reaching posterior coxae; segments 3 and 4 equal; 5-10 each one-half longer but no broader than 4; 11 rounded, but slightly longer than 10. Apical segment of maxillary palpi enlarged, form of a scalene triangle, sides straight, angles rounded. Pronotum distinctly broader than long (0.7 by 0.6 mm), sides rounded, basal angles obtuse, midbasal lobe distinct, rounded. Scutellum small, rounded. Elytra more than twice as long as broad (1.65 by 0.7 mm), sides gently rounded, apices individually curved. Posterior tibiae with two oblique ridges, the anterior extending en-

tirely across outer face; basitarsi and second segment each with two oblique ridges, all extending halfway across outer surface. Anal style three times as long as apical ventral segment, slender, attenuate to apex.

*Type locality*.—Juana Diaz, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51604.

*Remarks*.—The type and a male paratype were both taken at Juana Diaz on April 10, 1933, on leaf of *Inga laurina* by R. G. Oakley.

MORDELLISTENA LUCIDOVIRGA, new species

FIGURE 28, *f, m*

This species is most closely allied to *ephippium*, described below, and can be separated by the different color and maculation of the entire body, the two ridges on the hind basitarsus, and the different shape of the terminal segment of the maxillary palpus.

Length: 2.15 mm; including anal style, 3 mm. Elongate, narrowly subcuneate; derm of head and thorax fuscous with fuscocastaneous margins; elytra piceous, with a broad castaneous discal stripe extending from base almost to apex; antennae fuscocastaneous; maxillary palpi and legs flavous, except posterior femora, which are black; ventral surface piceous. Surface densely covered with fine recumbent pubescence, partaking of ground color.

Antennae 0.75 mm long, reaching posterior coxae; segments 3 and 4 equal; 5–10 each one-half longer but very little broader than 4; 11 rounded, slightly longer than 10. Apical segment of maxillary palpi enlarged, triangular, outer margin concave, other sides straight, corners rounded. Pronotum slightly broader than long (0.65 by 0.6 mm), sides rounded, base arcuate, midbasal lobe short, rounded. Scutellum small, triangular. Elytra almost three times as long as broad (1.55 by 0.65 mm), sides narrowly rounded, apices individually curved. Posterior tibiae with two oblique ridges, the anterior extending entirely across outer face; basitarsus and second segment each with two ridges, each extending halfway across outer surface. Anal style two and one-half times as long as apical ventral segment, stout, truncate at apex.

*Type locality*.—Maricao, Puerto Rico.

*Type*.—Female, U.S.N.M. no. 51605.

*Remarks*.—The type, a unique, was taken at Maricao on July 2, 1917, by H. Morrison.

MORDELLISTENA EPHIPPIMUM, new species

FIGURE 28, *c, e, p*

The separation of this form from its closest ally, *lucidovirga*, has been recorded under the description of the latter species.

Length: 2.25 mm; including anal style, 3.25 mm. Elongate, subparallel, derm flavous, except for the following piceous areas: Margins and suture of elytra and a premedian, transverse fascia, which is broadest near side margins. Surface densely covered with fine, recumbent, flavous pubescence, except on anal style, where color is fuscous.

Antennae 0.8 mm long, reaching posterior coxae; segments 3 and 4 equal; 5-10 each one-half longer and considerably broader than 4; 11 rounded, one-half longer than 10. Apical segment of maxillary palpi enlarged, form of a scalene triangle, sides straight, corners rounded. Prothorax slightly broader than long (0.6 by 0.55 mm), convex, sides rounded, basal angles obtuse, midbasal lobe short, subtruncate. Scutellum small, triangular. Elytra almost three times as long as broad (1.7 by 0.6 mm), sides subparallel, apices individually rounded. Posterior tibiae with two oblique ridges, the anterior extending entirely across outer face; basitarsi with three oblique ridges, second segment with two, all extending halfway across outer surface. Anal style twice as long as apical ventral segment, attenuate to apex.

*Type locality*.—Aibonito, Puerto Rico.

*Type*.—Male, U.S.N.M. no. 51606.

*Remarks*.—The type was taken at Aibonito on June 8, 1934; the allotype was taken at Ponce on September 11, 1933. Both were collected on *Eugenia* sp. by R. G. Oakley.

# LITERATURE CITED

FABRICIUS, JOHANN CHRISTIAN.

1801. *Systema eleutheratorum secundum ordines, genera, species, etc.*, vol. 2, 687 pp.

LECONTE, JOHN LAWRENCE.

1862. Synopsis of the Mordellidae of the United States. *Proc. Acad. Nat. Sci. Philadelphia*, vol. 14, pp. 43-51.

MÄKLIN, FREDRIK WILHELM.

1875. Neue Mordelliden. *Acta Soc. Sci. Fennicae*, vol. 10, pp. 561-595.

QUEDENFELDT, GUSTAV.

1886. Neue und seltnere Käfer von Portorico. *Berliner Ent. Zeitschr.*, vol. 30, pp. 119-128, 1 fig.

SMITH, JOHN BERNARD.

1882. A synopsis of the Mordellidae of the United States. *Trans. Amer. Ent. Soc.*, vol. 10, pp. 73-100, 3 pls.







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## OBSERVATIONS ON THE BIRDS OF WEST VIRGINIA

By ALEXANDER WETMORE

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EXAMINATION of specimens of eastern birds in recent years has brought constantly to attention the few specimens available from the State of West Virginia, not only in the National Museum collections but elsewhere. Much of what has been known of ranges in the group concerned in this area has been based on assumption, or on material obtained somewhat casually from scattered points. In the spring of 1936 it was decided to take up a definite program of field work in the State, made possible through funds provided in part by the National Museum and in part by the Smithsonian Institution. The work was planned to include collection both of birds and of small mammals. W. M. Perrygo was assigned to this work with Carleton Lingeback as assistant, while Dr. Remington Kellogg, assistant curator of mammals, accompanied the party for the first two weeks in the field to give instruction in the trapping of small mammals and in the general technique of other work.

The party left Washington on April 16, 1936, and continued work until July 10, when through the advance of the season birds were in poor plumage. Work began in the fall on September 16 and continued until November 7.

The accompanying account gives in detail the birds collected, with pertinent data concerning them. In it I have included additional information from my own observations made in West Virginia at various times during the past five years, as well as records from the few specimens previously in the National Museum that have come from scattered sources, including the grouse taken by E. A. Preble, who visited the Cranberry Glades in 1909. and specimens obtained by

A. H. Howell, who collected in Raleigh County in July 1909, for the Biological Survey. No attempt is made to give a complete list of the birds of the State, as others have that in hand. The intention of this paper is to make available the data we have for the use of those interested in the ornithology of this area either in compiling the State list or in other ways. The work has led to the description of a new race of song sparrow with the type locality in the Cranberry Glades, to several new records for West Virginia, and to much data on distribution within the limits concerned.

An account of the mammals collected has been prepared by Dr. Kellogg.<sup>1</sup>

The Conservation Commission of West Virginia has given most courteous assistance in these investigations in the granting of the necessary scientific permits and in other ways. We are especially indebted to H. W. Shawhan, the Commission's director of conservation, and to G. H. Overholt, executive secretary. Permission for work in the Cranberry Glades was granted by the Forest Service of the U. S. Department of Agriculture, through B. A. Eger, then district ranger of the Monongahela National Forest at Richwood, who made a cabin available for the use of the party. William L. Maule, district ranger, U. S. Forest Service, Durbin, W. Va., kindly arranged for the use of an excellent cabin on Middle Mountain during work in that area.

Finally we have to express our sincere appreciation of the friendly interest of many citizens and landowners throughout the State who aided the party by giving advice as to good localities and above all by freely granting permission to enter on their lands.

#### ITINERARY

The first collections of birds were made on April 18, 1936, in the mountainous country 2 miles east of White Sulphur Springs. On April 19 the party obtained quarters at Wilson's Farm Tourist Camp, near Barboursville, 4 miles east of Huntington, and remained there until May 4. From this base collections were made in the drainage of the Guyandot River and Twelve Pole Creek, the area worked extending to the region north of Logan and to points near Dunlow, Mill Creek, Tyler Creek, and Fourteen.

A base was established next at Uncle Tom's Cabin Camp near Gilboa, Nicholas County, where the party remained until May 17. This was a hilly region of farmland and forest. Localities at which collections were made included Pine Creek near Enon, Zela, Summersville, an open region near Muddlety, and the Gauley River near Persinger. I joined the party here on May 8, and on May 9 we made a reconnaissance into the Cranberry Glades.

<sup>1</sup> Proc. U. S. Nat. Mus., vol. 84, no. 3022.

On May 18 the party moved to Summersville, working that day near Drennen, and on May 19 they shifted quarters to Grantsville. From here collections were made along the Little Kanawha River, and in the vicinity of Big Bend, Freed, Big Springs, Smithville, MacFarlan, Walker, Arnoldsburg, Rocksdales, Mount Zion, and White Pine. The party moved to Philippi on May 27, when, through the kind permission of W. M. Bolton, they established camp on a farm 5 miles east of town in a rolling, upland country of open fields and hardwood forests, cut by the valleys of small streams. Collections here were made mainly near Sugar Creek and Bills Creek. On June 6 camp was broken, a trip was made to Moatsville, and the party continued to Richwood.

On June 8 work began in the Cranberry Glades area, to continue until June 20. A cabin on the south fork of the Cranberry River furnished comfortable quarters from which the forests and open lands of the Glades were easily accessible. On June 9 birds were collected on Kennison Mountain to 4,000 feet elevation and on June 20 on Black Mountain to 4,600 feet.

Work in the mountain area was continued on Cheat Mountain from a camp established at Cheat Bridge on June 23, on land belonging to Mr. Cromer. The weather here was cold and rainy. Collections were made up to 4,000 feet in forests of hardwood interspersed with hemlock and occasional stands of spruce, the area covered being mainly 3 to 5 miles northwest of camp and extending along the higher ridges. On June 27 the party moved to a ranger cabin on Middle Mountain, 12 miles northeast of Durbin. With its extensive forests this was one of the most interesting regions examined. Blister Swamp, The Sinks, The Big Burn, and Yokum Knob were visited successively, work terminating on July 5. The following day the party moved to Harman, where they made the final collections of the summer at Red Creek on Rich Mountain, at Flanagans Hill, and in Canaan Valley near Elk in Tucker County. The summer trip terminated here on July 10.

On September 17 work began from a camp on the farm of M. Bennett located under the summit of Spruce Knob, the highest mountain in the State. In spite of cold rainy weather, collections were made here along the ridge of the mountain, both in the forests of the slopes and over the stony summit, with its open pastures and dense stands of low bushes. From September 25 to 27 Perrygo was again at Cheat Bridge for further work on Cheat Mountain. On September 28 he worked the slopes of Smoke Camp Mountain east of Thornwood. On October 1 a broad-winged hawk was taken at Richwood, and on October 2 the men crossed through the Cranberry Glades to a camp on Williams River over a newly constructed road. Rainy, foggy weather prevailed until they left for Richwood on October 10. Collections were made near Gilboa on October 12.

On October 14 the party moved to Flat Top to collect over the slopes of Flat Top Mountain. The work here extended to Odd and Ghent. On October 22 they moved to Whitesville, from which point they covered Cherry Pond Mountain, the specimens taken being labeled Arnett and Posey. On October 24 they worked near Orgas in Boone County, and on October 25 they moved to Wilson's Farm Camp near Barboursville east of Huntington. From here they collected near Barboursville, Point Pleasant, Ben Lomond, Mercers Bottom, Ashton, and near Huntington, the area covered being principally near the Ohio River. Heavy rains caused some delays here. On November 5 they moved to White Sulphur Springs and collected on Katis Mountain on November 6 and 7. This completed the work of the season.

### Family ARDEIDAE

*BOTAURUS LENTIGINOSUS* (Montagu)

#### AMERICAN BITTERN

One, evidently a bewildered migrant, was taken 4 miles east of Huntington, April 25, 1937, as it rested in a bush in a yard distant from any body of water.

### Family CATHARTIDAE

*CORAGYPS ATRATUS ATRATUS* (Meyer)

#### BLACK VULTURE

On May 24, 1936, I saw half a dozen circling with a large flock of turkey vultures near Wardensville. The species is one that seems to have extended its range into the State rather recently, this being the most northern record known to me at this time.

### Family ACCIPITRIDAE

*ACCIPITER VELOX* (Wilson)

#### SHARP-SHINNED HAWK

An immature female was taken on the summit of Spruce Knob, Pendleton County, at 4,800 feet on September 21, 1936. Others were seen on the two following days. Early in the summer one was observed near Freed on May 21.

According to M. Bennett, whose farm near the summit of Spruce Knob is reputed to be the highest land under cultivation in West Virginia, there is a regular hawk migration over this mountain late in fall. At times the birds have been observed by thousands, among them "booted hawks", which probably are the American roughleg.

**BUTEO JAMAICENSIS BOREALIS (Gmelin)****EASTERN RED-TAILED HAWK**

Found nesting in small numbers through the mountainous section of the State. Several were recorded near Muddlety on May 14, and one was seen near Philippi on May 28. Two or three pairs were found in the Cranberry Glades, and an adult female was taken here on June 16. In the Middle Mountain area the birds were common and tame, as in this remote section they have until now been little disturbed. A dozen or more pairs were observed here without particular search for them. An adult female was secured on Little Middle Mountain near Yokum Knob, Randolph County, on July 4. The birds nest early in this area as a fully grown immature bird was secured on Middle Mountain in Pocahontas County, 9 miles west of Durbin on June 30. The rectrices in this specimen still have short down adhering at the tip, the only indication of juvenile condition in the plumage. Several were observed on Spruce Knob on September 19, and on Williams River on October 3.

The specific name of the red-tailed hawk is *jamaicensis*, as indicated above.

**BUTEO LINEATUS LINEATUS (Gmelin)****NORTHERN RED-SHOULDERED HAWK**

A breeding record of interest is that of an adult male secured at the nest and a young bird in down just from the egg secured 3 miles south of Huntington on May 2, 1936.

**BUTEO PLATYPTERUS PLATYPTERUS (Vieillot)****BROAD-WINGED HAWK**

A female in full adult dress was shot near Richwood on October 1, 1936. This species was observed in addition as follows: Logan, April 22; Fourteen, April 28; Gilboa, May 5; Grantsville, May 20; and Philippi, May 31.

**BUTEO LAGOPUS S. JOHANNIS (Gmelin)****AMERICAN ROUGH-LEGGED HAWK**

In view of the few records for the State, it is of interest to report two seen on Spruce Knob on September 22.

**AQUILA CHRYSÆTOS CANADENSIS (Linnaeus)****GOLDEN EAGLE**

This great bird may still nest in West Virginia, as one was seen at The Sinks on Middle Mountain on July 4. Others were recorded on Spruce Knob on September 22 and east of Huntington on October 27.

## CIRCUS HUDSONIUS (Linnaeus)

## MARSH HAWK

One was seen near Ashton on October 31.

## PANDION HALIAETUS CAROLINENSIS (Gmelin)

## OSPREY

One was seen near Dunlow on April 22.

## Family FALCONIDAE

## FALCO PEREGRINUS ANATUM Bonaparte

## DUCK HAWK

One was recorded at Kanawha Falls on May 4.

## Family TETRAONIDAE

## BONASA UMBELLUS TOGATA (Linnaeus)

## CANADA RUFFED GROUSE

The ruffed grouse is widely distributed through forested sections of the State particularly in the mountains. Early in the morning of September 30, 1935, I found one in the highway near Cherry Grove, south of Circleville, that had been killed by flying into a car. Others were collected in the Cranberry Glades and on Middle Mountain northeast of Durbin. In the Biological Survey collection there are two taken in the Cranberry Glades on November 24 and 26, 1909, by E. A. Preble. Grouse were observed near White Sulphur Springs, April 18; at Fourteen, April 29; Gilboa, May 5; Cranberry Glades, May 9 and June 10 and 11; Persinger, May 16; Thornwood, July 10 and September 28, 1936, and January 1, 1937; Spruce Knob, September 30, 1935, and September 18 to 23, 1936; Williams River, October 7; Flat Top Mountain near Ghent, October 14; and near McCauley, October 13, 1935, and April 19, 1936.

After careful comparison of a good series of eastern ruffed grouse, I have identified the West Virginia birds as of the subspecies *togata*, though they have been assumed previously to be the typical form *umbellus*. Following is a summary of my understanding of the characters of the two forms under consideration:

*Bonasa umbellus umbellus*

Dark markings on lower surface much reduced so that the breast appears very light, almost white; under tail-coverts whiter.

The typical form of the ruffed grouse, *Bonasa umbellus umbellus*<sup>2</sup> is based on Edwards' account of the "Ruffed Heath-cock or Grouse."<sup>3</sup>

<sup>1</sup> *Tetrao umbellus* Linnaeus, Syst. Nat., ed. 12, vol. 1, 1766, p. 275.

<sup>2</sup> Gleanings of natural history, 1758, p. 79, pl. 248.

Edwards says that the bird was sent from Pennsylvania by John Bartram to Peter Colinson, which would place the type locality in eastern Pennsylvania. The characters outlined above are taken from skins from southeastern New York (Highland Falls and West Point). A bird from Carlisle, Pa., is similar though somewhat more heavily marked. Others come from Piseco, N. Y., and Glenwood in southeastern Michigan. Birds from near Washington, D. C., and Laurel, Md., are somewhat more heavily barred below but for the present are placed with the typical race.

*Bonasa umbellus togata*

Markings on lower surface abundant, dark, and broad, the cross bars being predominant in the coloration of this area; under tail-coverts with more brown.

Specimens from Calais, Maine, and Carberry and Rat Portage, Manitoba, are taken as typical of this form. One from Springfield, Mass., also belongs here, as does one from Hunter, in the Catskill Mountains of New York, this bird being somewhat intermediate.

On careful comparison I find that specimens from Johnstown in western Pennsylvania, Virginia, West Virginia, Tennessee, and northern Georgia agree with the northern birds. Though very slightly browner above than the average from the north, in view of the rufescent color phase found so commonly in ruffed grouse I feel that this apparent slight difference is unreliable and of no definite importance. It appears that the subspecies *togata* extends southward through the mountains as far as Georgia.

Peters<sup>4</sup> attributes birds of the Appalachian region to both *umbellus* and *togata*.

Family PERDICIDAE

COLINUS VIRGINIANUS VIRGINIANUS (Linnaeus)

EASTERN BOBWHITE

An adult male was obtained 3 miles north of Big Bend, Calhoun County, May 21, 1936. There is also a bird about three-fourths grown that I found lying dead in the road near the southern limits of Elkins on September 30, 1935. Others were observed near Gilboa, May 15; near Freed, May 21; and near Grantsville, May 26.

Family PHASIANIDAE

PHASIANUS COLCHICUS Linnaeus

PHEASANT

A female from Mercers Bottom, Mason County, taken on October 30, 1936, has the reddish brown of the hindneck, and the general color of the upper surface paler than in wild-killed specimens of the

<sup>4</sup> Check-list of birds of the world, vol. 2, 1934, p. 40.



typical ringneck (*Phasianus colchicus torquatus*) of southeastern China. It thus carries a lighter coloration, suggestive of typical *colchicus*.

### Family RALLIDAE

PORZANA CAROLINA (Linnaeus)

SORA

Two or three were seen and one was taken in a swampy meadow near Muddlety in Nicholas County, May 11, 1936. It was believed that they were nesting. One was observed on October 14 in a glade near Ghent on Flat Top Mountain.

### Family CHARADRIIDAE

OXYECHUS VOCIFERUS VOCIFERUS (Linnaeus)

KILLDEER

A young bird barely able to fly was taken 7 miles east of Philippi on June 4, 1936. One was seen near Moorefield on June 5, 1935.

### Family SCOLOPACIDAE

PHILOHELA MINOR (Gmelin)

AMERICAN WOODCOCK

One was recorded in the Cranberry Glades on June 10.

### Family COLUMBIDAE

ZENAIIDURA MACROURA CAROLINENSIS (Linnaeus)

EASTERN MOURNING DOVE

Males were collected 5 miles east of Huntington on April 20 and near Ashton, Mason County, on October 31. These birds were far from common in the localities visited. They were noted near Beaver Dam on Middle Mountain in June.

### Family CUCULIDAE

COCCYZUS AMERICANUS AMERICANUS (Linnaeus)

YELLOW-BILLED CUCKOO

Two males were secured on Cheat Mountain at an elevation of 3,800 feet on September 25 and 26, one coming from 3 miles west and one from 8 miles northwest of Cheat Bridge.

COCCYZUS ERYTHROPHthalmus (Wilson)

BLACK-BILLED CUCKOO

Specimens were obtained on Pine Creek, near Enon, on May 8; near Muddlety, Nicholas County, May 13; 5 miles east of Philippi, May 30; and in the Cranberry Glades, Pocahontas County, June 15. The last two were certainly on their breeding grounds. One was seen near Persinger on May 16.

## Family STRIGIDAE

STRIX VARIA VARIA Barton

NORTHERN BARRED OWL

On June 24 a young bird not quite grown was found on Cheat Mountain, 3 miles west of Cheat Bridge. An adult female was shot on Middle Mountain 12 miles northeast of Durbin on June 29, and a female 9 miles northeast of Durbin on June 30. In the Cranberry Glades in June barred owls were heard calling regularly at night. Those taken show the extent of feather development on the toes characteristic of the northern race.

CRYPTOGLAUX ACADICA ACADICA (Gmelin)

ACADIAN OWL

The first breeding record for this owl in West Virginia was reported by A. B. Brooks<sup>5</sup> on the basis of an immature bird found June 22, 1932, near Cranesville in Preston County. The locality is in the extreme northern part of the State not far from the western boundary of Garrett County, Md. On June 12, 1936, Perrygo and Lingeback found an Acadian owl resting in a hole in a dead tree in the Cranberry Glades of Pocahontas County, at an elevation of 3,300 feet. The bird was obtained with some difficulty and proved to be an immature female, fully grown and on the wing but in juvenal dress. This is the most southern breeding record for this species in the East.

This particular specimen is decidedly darker above than a series of a dozen in comparable plumage in the National Museum, suggesting that there might be a local race in this area. To examine into this W. E. Clyde Todd has permitted study of the specimen reported by Brooks, which now is mounted in the Children's Museum, in the Carnegie Museum (Catalog no. 111804, prepared by Reinhold L. Fricke). This bird proves to resemble those from elsewhere in color, so that the darker shade of the Cranberry Glades specimen is assumed to be an individual variation.

## Family MICROPODIDAE

CHAETURA PELAGICA (Linnaeus)

CHIMNEY SWIFT

Fairly common about houses throughout the area covered. A male was collected on Middle Mountain 12 miles northeast of Durbin on June 27.

<sup>5</sup> Auk, 1933, p. 361

## Family PICIDAE

## COLAPTES AURATUS LUTEUS Bangs

## NORTHERN FLICKER

The flicker is universally distributed through the State, six males and six females being included in the collection. Birds taken in the breeding season, except in the northern section, are small and show definite approach to the southern form, *Colaptes auratus auratus*. A female from the south side of the Guyandot River near Huntington taken on May 2 has the wing only 149.8 mm, suggesting the desirability of further material from this area to determine whether breeding birds may not be the southern subspecies. Another from 5 miles east of Huntington, secured on April 21, measures 152.5 mm, but judged from the date it may be a migrant from farther north. Males from near Muddlety, May 14 (wing, 148.5), and Persinger, May 16 (wing, 151.2), are somewhat worn, as is one from the Cranberry Glades, June 18 (wing, 151.2), and one from near Yokum Knob on Middle Mountain, July 4 (wing, 150.7). A male from 7 miles east of Philippi, Barbour County, June 2 (wing, 156) is distinctly large. A series of three females taken near Flat Top, Mercer County, on Flat Top Mountain, October 20, range in wing measurement from 154 to 161 mm and may be migrants from the north. The mountain birds are somewhat worn and so would have shorter wings, but this does not hold in the small specimen from near Huntington. After careful consideration all are identified as of the northern race.

## CENTURUS CAROLINUS (Linnaeus)

## RED-BELLIED WOODPECKER

This species, only fairly common, was collected in Nicholas County on Pine Creek near Enon, May 8, and at Gilboa, October 12; in Barbour County, 5 miles east of Philippi, May 28; and in Pocahontas County, at an elevation of 3,600 feet on Red Lick Mountain, October 9. An adult male from near Philippi has a suffusion of pink extending across the throat.

## MELANERPES ERYTHROCEPHALUS ERYTHROCEPHALUS (Linnaeus)

## EASTERN RED-HEADED WOODPECKER

The present species is somewhat erratic in occurrence. Breeding birds were taken near Yokum Knob on Middle Mountain in a locality known as The Sinks on July 4. In fall these birds were abundant on Cherry Pond Mountain, Raleigh County, near Arnett, where two adults and one immature bird were taken October 20, and near Posey in the same county, where three more, including another immature bird, were secured October 23. It seems evident that they were established at these points for the winter. The species was observed

near Drennen on May 18, near Philippi on May 29 and 31, and near Petersburg on January 1, 1937.

On considering the measurements as given by Oberholser<sup>6</sup> and Brodkorb<sup>7</sup> for eastern and western groups in this species, I find that the average difference in wing length for the two is approximately 5 percent. In view of this constant difference there seems to be no reason for refusing to accept the western race, which in my opinion should be called *Melanerpes erythrocephalus caurinus* Brodkorb.

SPHYRAPICUS VARIUS (Linnaeus)

YELLOW-BELLIED SAPSUCKER

Specimens were obtained as follows: Five miles east of Huntington, April 20 to 22; Tyler Creek, April 27; Pine Creek, near Enon, May 8; Cranberry Glades, May 9 and June 19; Middle Mountain, 12 miles northeast of Durbin, June 29; Williams River, October 3 and 5; Thornwood, September 28; Cheat Mountain, 8 miles northwest of Cheat Bridge, September 26; Orgas, Boone County, October 24; 3,200 feet elevation on Flat Top Mountain, Mercer County, October 15. One was taken at 4,600 feet on Spruce Knob, September 30, 1935.

The species nests in some numbers in the mountain area.

DRYOBATES VILLOSUS VILLOSUS (Linnaeus)

EASTERN HAIRY WOODPECKER

This widely distributed woodpecker was taken as follows: Katis Mountain, 3,000 feet, near White Sulphur Springs, November 6; Flat Top Mountain, 3,000 and 3,200 feet, near Flat Top, October 15 and 20; Posey, Raleigh County, October 23; 5 miles north of Drennen, Nicholas County, May 18; 12 miles north of Logan, April 22; Fourteen, April 28; Middle Mountain, 11 miles northeast of Durbin, July 2; Rich Mountain, 7 miles south of Harman, July 7; Cranberry Glades, 3,300 to 3,800 feet, June 11 and 19; Little Spruce Mountain, 3,500 feet, above Williams River, October 5; 7 miles east of Philippi, June 2.

Measurements are as follows:

Eight males: Wing, 116.5–125 (120.4); tail, 60–71 (66.4); culmen from base, 27.5–33 (29.7); tarsus, 21.5–24 (23) mm.

Six females: Wing, 115.5–121.5 (117.6); tail, 63–73 (66.5); culmen from base, 24.5–26 (25.1)<sup>8</sup>; tarsus, 19.5–24 (21) mm.

All come within the range of size characteristic of the form *villosus* with no definite approach to the smaller *auduboni* of the south.

<sup>6</sup> Can. Field-Nat., vol. 33, 1919, p. 48.

<sup>7</sup> Occ. Pap. Mus. Zool. Univ. Michigan, no. 303, 1935, p. 2.

<sup>8</sup> Five individuals.

## DRYOBATES PUBESCENS MEDIANUS (Swainson)

## NORTHERN DOWNY WOODPECKER

Universally distributed throughout the State, including the mountainous section. Recorded as follows: 12 miles north of Logan, April 22; Tyler Creek, April 27; Orgas, Boone County, October 24; Barboursville, Cabell County, October 26 and November 3; Mercers Bottom, Mason County, October 30; Ashton, October 31; 3 miles north of Point Pleasant, October 27; Gilboa, Nicholas County, October 12; West Fork River near Rocksedale, Calhoun County, May 23; 7 miles east of Philippi, June 2; Rich Mountain, 7 miles south of Harman, July 8; 3,950 feet elevation on Smoke Camp Mountain, 3 miles east of Thornwood, September 28; 4,600 to 4,800 feet elevation on Spruce Knob, September 22 and 23; 3,500 feet on Little Spruce Mountain, Williams River, October 5; 3,700 to 3,800 feet, Cranberry Glades, June 9, 19, and 20; Cheat Mountain above Cheat Bridge, June 27; 2,900 feet on Flat Top Mountain, near Flat Top, October 19; 2 miles east of White Sulphur Springs, April 18.

Measurements are as follows:

Males: Wing, 90-97 (94.2); tail, 50-58 (53); culmen from base, 17-20 (17.2); tarsus, 15-18 (16.2) mm.

Females: Wing, 91-99 (93.8); tail, 51-56.5 (54.2); culmen from base, 16-19 (17.1); tarsus, 15.5-18 (16.3) mm.

All come within the size range of *medianus* and are identified as that race. The largest individuals come from the mountain area particularly in the section above Williams River, and the smallest from along the Ohio River, but the differences are relatively slight.

## Family TYRANNIDAE

## TYRANNUS TYRANNUS (Linnaeus)

## EASTERN KINGBIRD

This species is found locally throughout the State, except in heavy forests. Specimens were obtained at Walker, Wirt County, May 22; 5 miles east of Philippi, Barbour County, May 30; near Persinger, Nicholas County, May 16; on Flanagans Hill, near Elk, Tucker County, July 6; and at The Sinks, near Yokum Knob on Middle Mountain, July 4.

## MYIARCHUS CRINITUS BOREUS Bangs

## NORTHERN CRESTED FLYCATCHER

Birds were obtained in the hills south of the Guyandot River near Huntington, May 2, near Grantsville, Calhoun County, May 20 and 26, and 5 miles east of Philippi, Barbour County, May 29.

## SAYORNIS PHOEBE (Latham)

## EASTERN PHOEBE

The phoebe, fairly common throughout the State, was obtained at Fourteen near the Guyandot River, April 28; Zela, Nicholas County, May 13; Freed, May 21; Big Springs, May 22; and Mount Zion, May 23. In fall specimens were secured in the Cranberry Glades at 3,600 feet elevation on October 2, near Ghent, at 2,900 feet on Flat Top Mountain, October 14, and near Orgas, Boone County, October 24.

## EMPIDONAX VIRESCENS (Vieillot)

## ACADIAN FLYCATCHER

This species was secured at Summersville May 13; 5 miles north of Drennen in Nicholas County, May 18; and along the Kanawha River near Grantsville, Calhoun County, May 20.

## EMPIDONAX MINIMUS (Baird and Baird)

## LEAST FLYCATCHER

A female was taken at 3,300 feet in the Cranberry Glades on June 16. From the date it is assumed to be a breeding bird. The wing measures 61 mm.

## MYIOCHANES VIRENS (Linnaeus)

## EASTERN WOOD PEWEE

Taken in the Cranberry Glades on June 13 and 7 miles east of Philippi on June 1 and 2.

## Family ALAUDIDAE

## OTOCORIS ALPESTRIS PRATICOLA Henshaw

## PRAIRIE HORNED LARK

This lark nests sparingly in open country at various points. One was observed near Wardensville on April 19, and one near Nettie on May 9, both evidently being on the nesting grounds. Specimens were taken near Walker in Wirt County and in the vicinity of Smithville, Ritchie County, on May 22, and 7 miles east of Philippi on June 4.

## Family HIRUNDINIDAE

## HIRUNDO RUSTICA ERYTHROGASTER Boddaert

## BARN SWALLOW

A widely distributed bird that was taken 4 miles south of Wayne on May 1; near Muddlety, Nicholas County, May 14; and on Middle Mountain, 9 miles northeast of Durbin, June 30.

After consideration of the variations found in the Old World swallows of this type, particularly of *Hirundo rustica gutturalis*, *transitiva*, and *tytleri*, it seems reasonable to include the American

birds under the same specific name. While typical *rustica* of western Europe has a pronounced black band across the breast, this becomes interrupted in part at least of the birds of eastern Asia, some specimens of *tytleri* especially being very closely similar to *erythrogaster*. On this basis the American birds will be called *Hirundo rustica erythrogaster*.

## Family CORVIDAE

### CYANOCITTA CRISTATA CRISTATA (Linnaeus)

#### NORTHERN BLUE JAY

In the breeding season blue jays were obtained only at Persinger, Nicholas County, May 16; on Cheat Mountain above Cheat Bridge, June 26; and in Blister Swamp on Middle Mountain, June 29, the last being a young bird recently from the nest. A few were noted in the Cranberry Glades on May 9 and June 10. The species seems rare as a nesting bird in the State, and of irregular occurrence in general.

In the migration season blue jays were commoner. Specimens were taken at 3,000 feet on Katis Mountain near White Sulphur Springs, November 6; at 2,900 feet on Flat Top Mountain near Ghent, October 14; at 2,000 feet on Cherry Pond Mountain near Arnett, October 23; and at 4,800 feet on Spruce Knob, September 21. Blue jays were seen on Williams River on October 5 and at Romney on January 1, 1937.

Three males taken in the breeding season measure as follows: Wing, 133.7 to 136.5; tail, 124.1–132.8; culmen from base, 26.3–27.7; and tarsus, 33.3–36.0 mm. In size these individuals average a little small, in this indicating possible approach to the southern race, but in color they resemble the northern form distinctly. Most of the fall birds are like those taken in the breeding season in size, though two, probably northern migrants, are distinctly larger.

### CORVUS CORAX PRINCIPALIS Ridgway

#### NORTHERN RAVEN

This fine bird is found in small numbers throughout the wilder sections of the mountains in the eastern part of the State. A male in full plumage taken at 4,860 feet on the summit of Spruce Knob, September 18, has the following measurements: Wing, 451; tail, 248; culmen from base, 75.8; height of bill at nostril, 27.9; and tarsus, 66.6 mm. I saw several at this same place on September 30, 1935, and Perrygo reports that during one period of storm with heavy rain, on September 18, he counted 25 resting near one another on rocks on the summit of the mountain. Mr. Bennett, resident here, says that in winter they are sometimes present in numbers.

A female taken 6 miles south of Harman, July 6, 1936, measures as follows: Wing, 405; tail, 223; culmen from base, 63.2; depth of

bill at nostrils, 26.0; and tarsus, 54.7 mm. This specimen is in somewhat worn dress.

In addition to the above I noted one flying low over cultivated fields at Circleville on October 1, 1935, and another on Lost River near McCauley on October 13. Near this same postoffice I observed one on May 24, 1936, above the slopes of Short Mountain. Perrygo recorded them also on Kennison Mountain, bordering the Cranberry Glades, June 9, and on Cheat Mountain above Cheat Bridge June 27. They were seen at The Sinks on Middle Mountain on July 4, and on Rich Mountain south of Harman on July 6 and 7. One was recorded near Thornwood on July 10.

**CORVUS BRACHYRHYNCHOS BRACHYRHYNCHOS Brehm**

**EASTERN CROW**

An adult male crow taken with a young bird just from the nest 5 miles west of Grantsville, Calhoun County, has the following measurements: Wing, 315; tail, 187; culmen from base, 50.5; tarsus, 62.8 mm. It is identified as *C. b. brachyrhynchus*, which should nest through the extreme northern and northwestern part of the State.

**CORVUS BRACHYRHYNCHOS PAULUS Howell**

**SOUTHERN CROW**

Following are specimens ascribed to the southern race of the crow: Wayne, May 1; Mercers Bottom, November 3; Ben Lomond, October 28; and Cranberry Glades, June 18. A young bird just from the nest was taken in the latter locality on June 15.

From near Wayne a male measures as follows: Wing 286, tail 156, culmen from base 48.8, and tarsus 62.1 mm; and a female: Wing 296, tail 178, culmen from base 45.1, and tarsus, 57.5 mm. A male from Mercers Bottom has the wing 295, tail 176, culmen from base 45.9, and tarsus 55.6 mm, and a female from Ben Lomond measures: Wing 296, tail 178, culmen from base 45.1, and tarsus 57.5 mm. A breeding male from the Cranberry Glades has the wing 306, tail 175, culmen from base 47.5, and tarsus 59.7. All these fall within the size range of shorter wing and smaller bill assigned to *C. b. parulus*. From this material it appears that the southern crow ranges from the central part of the State southward.

**Family PARIDAE**

**PENTHESTES ATRICAPILLUS ATRICAPILLUS (Linnaeus)**

**BLACK-CAPPED CHICKADEE**

This bird was recorded as follows: 2 miles east of White Sulphur Springs, April 18; 3,000 feet elevation on Katis Mountain, above White Sulphur Springs, November 6; 3,800 feet elevation on Cheat Mountain, 3 miles west of Cheat Bridge, June 25 and September 26;



Middle Mountain, 11 miles northeast of Durbin, July 2; Cranberry Glades, May 9 and June 8 and 13; 4,600 feet and 4,800 feet on Spruce Knob, September 30, 1935, and September 21, 1936; and 3,000 feet elevation above Williams River, October 3. I have also a male that I secured on Short Mountain, above Lost River, near McCauley, October 13, 1935, and have record of another seen here May 24, 1936. Judged from the above, this is the chickadee of the mountainous area of the eastern part of the State.

The series of birds from West Virginia when compared with specimens from New York, New England, and Ontario average very slightly darker on the back, with somewhat restricted light edgings on wing and tail feathers. They also appear smaller in bulk, though this difference does not register in the usual measurements of wing, tail, culmen, and tarsus. The northern birds, it is observed, have distinctly longer and fluffier feathers, the apparent greater bulk coming possibly from this source. The differences in color, especially evident in fall plumage, are tenuous and at present do not seem to warrant a subspecific name. It would be interesting to compare a series of records of body weights from the two areas.

PENTHESTES CAROLINENSIS EXTIMUS Todd and Sutton

NORTHERN CAROLINA CHICKADEE

A common bird through the lowland areas of the State. Specimens were secured as follows: 5 miles east of Huntington, April 21; near Dunlow, April 23; near Fourteen, April 28; 2 miles east of Ben Lomond, October 28; near Barboursville, October 26 and November 3; 5 miles east of Philippi, May 29; 2,000 feet elevation on Cherry Pond Mountain, near Arnett, October 23; and 2,900 feet elevation on Flat Top Mountain, near Ghent, October 14.

It is interesting to find this species on the somewhat isolated Flat Top and Cherry Pond Mountains in the southeastern part of the State when the black-capped chickadee ranges in the mountains from White Sulphur Springs northward.

The type locality of the true Carolina chickadee (*Penthestes carolinensis carolinensis*) is Charleston, S. C. Birds from the northern part of the range of the species have been separated recently by Todd and Sutton<sup>1</sup> as *Penthestes carolinensis extimus*. On comparison of specimens it develops that the northern birds average slightly larger, are lighter in color on the back, and have the sides and flanks brighter buffy brown. The color differences are evident mainly in birds taken in fall and winter. While the distinctions are not very great, they seem sufficient to warrant recognition of a northern race.

<sup>1</sup> Proc. Biol. Soc. Washington, vol. 49, July 3, 1936, p. 70 (Bethany, W. Va.).

Following are measurements of birds from the West Virginia localities listed above, with an additional male from Bethany presented by Dr. Sutton:

Nine males: Wing, 59.0–64.9 (62.4); tail, 50.2–57.3 (53.7); culmen from base, 8.0–9.0 (8.5); tarsus, 15.0–16.2 (15.7) mm.

Five females: Wing, 58.0–60.0 (59.1); tail, 49.5–53.0 (51.5); culmen from base, 8.3–9.0 (8.7); tarsus, 14.7–16.2 (15.5) mm.

**BAEOLOPHUS BICOLOR (Linnaeus)**

**TUFTED TITMOUSE**

This titmouse is distributed abundantly through the State except in the higher elevations of the eastern portion. It was collected at the following localities: 5 miles east of Huntington, April 20; 12 miles north of Logan, April 22; Fourteen, April 27; 3 miles north of Point Pleasant, October 27; Barboursville, November 3; Gilboa, May 5; 2,000 feet elevation on Cherry Pond Mountain, near Arnett, October 23; near Philippi, May 29 and June 4. In addition to this, I observed it on Lost River near McCauley on October 13, 1935, and May 24, 1936, and near Upper Tract and Franklin on January 1, 1937.

Birds from South Carolina (Kershaw County and Port Royal) in winter have the brownish wash on the back slightly duller than those from West Virginia, but the difference is too slight in my opinion to merit distinction of a subspecific name.

**Family SITTIDAE**

**SITTA CAROLINENSIS CAROLINENSIS Latham**

**WHITE-BREASTED NUTHATCH**

Recorded as follows: Near Posey, Raleigh County, October 23; near Huntington, April 24 and May 2; 12 miles north of Logan, April 22; Gilboa, May 5 and October 12; West Fork River near Rocksedale, May 23 (including one bird just from the nest); 5 miles east of Philippi, May 5. It was seen at Freed on May 21 and on Spruce Knob on September 17.

Birds in breeding plumage appear somewhat darker than the average in the typical race, thus showing a tendency toward the southern form *atkinsi*. Those in fall plumage appear much lighter gray than *atkinsi*. There is indicated an approach toward the southern form, but the nuthatch of West Virginia is identified definitely as *carolinensis*.

**SITTA CANADENSIS Linnaeus**

**RED-BREASTED NUTHATCH**

A male secured at 3,000 feet elevation on Katis Mountain near White Sulphur Springs, November 6, was the only one observed.

Hartert <sup>10</sup> has listed *Sitta whiteheadi* Sharpe of the mountains of Corsica and *Sitta villosa* Verreaux of northern and northwestern China and Mongolia as subspecies of the North American red-breasted nuthatch. Hellmayr <sup>11</sup> also gives *villosa* as a race of the present species.

The Corsican nuthatch (*Sitta whiteheadi*) is similar to *Sitta canadensis* in general only, as it is decidedly larger, does not have the same under wing pattern and tail markings, and differs in coloration. Its resemblances to *canadensis* are in my opinion only those that place it in the same genus, and its differences are so great as to preclude its being considered specifically the same.

*Sitta villosa* is similar in size to *canadensis* but here close resemblance ceases, as it does not have the line through the eye distinctly black, the under tail coverts are not tipped with white, there is no definite white marking at the tips of the outer tail feathers, and the under wing pattern is not so strongly developed. In addition, the tone of color is much grayer. Here again the differences are so great, when coupled with distant distribution, as to forbid consideration of *villosa* as a race of *canadensis*.

### Family CETHIIDAE

#### CERTHIA FAMILIARIS AMERICANA Bonaparte

##### BROWN CREEPER

Specimens of this migrant form were taken 8 miles east of Huntington on November 1, and at 3,000 feet elevation on Katis Mountain, near White Sulphur Springs, on November 6.

#### CERTHIA FAMILIARIS NIGRESCENS Burleigh

##### SOUTHERN CREEPER

A female was taken at 3,800 feet on Cheat Mountain 3 miles west of Cheat Bridge, September 25. A pair was recorded at this point in June. Mr. Burleigh secured one at the Cranberry Glades in Pocahontas County on June 19, 1931.

This recently described race,<sup>12</sup> when compared with the form *americana*, as indicated in the original description, has the anterior part of the body, including the crown, darker, the tail more grayish, and the rump darker.

The coloration of the under surface in tree-creeper birds is so subject to stain that differences in color in this region are unreliable in making comparisons.

<sup>10</sup> Vög. pal. Fauna, vol. 1, June 1905, pp. 335-336.

<sup>11</sup> Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 7, 1934, p. 96.

<sup>12</sup> *Certhia familiaris nigrescens* Burleigh, Proc. Biol. Soc. Washington, vol. 48, May 3, 1935, p. 62 (Mount Mitchell, N. C.).

## Family TROGLODYTIDAE

## TROGLODYTES AEDON BALDWINI Oberholser

## OHIO HOUSE WREN

This recently described form <sup>13</sup> is darker in color above, with the brown duller and less rufescent, and the sides, flanks, and underparts grayer. Specimens assigned to this race were obtained as follows: 7 miles east of Philippi, Barbour County, June 3; Cave Creek Run, near Moatsville, Barbour County, June 6; Flanagans Hill, Canaan Valley, southern Tucker County, July 6; 3,000 feet elevation above Williams River, October 3; Cranberry Glades (where they were unusually abundant), June 12 to 16; Middle Mountain, 12 miles north-east of Durbin, June 29; and 4,860 feet elevation on Spruce Knob, September 19 and 23. These agree fairly well with a series from the type locality though averaging somewhat grayer above.

According to Oberholser (*l. c.*, p. 90) typical *aëdon* occurs at Charlestown in the extreme eastern part of the State, while possibly the western house wren (*T. a. parkmani*) might occur in the extreme west along the Ohio River as a migrant. Wrens seem to be rare in this western section, as none were recorded here during the work of 1936. The breeding bird of West Virginia, except for the extreme eastern section, seems to be the Ohio house wren.

Oberholser (*l. c.*, p. 87) uses *Sylvia domestica* Wilson (Amer. Ornith., vol. 1, 1808 [after Sept. 1], p. 5, description on p. 129, pl. 8, fig. 3) for the typical race of the house wren, designating Philadelphia as type locality, on his supposition that *Troglodytes aëdon* Vieillot (Ois. Amér. Sept., vol. 2, p. 52) appeared in May 1809. The title page of this volume, however, is dated 1807. Vieillot's work came out in parts, and Oberholser writes "since *Troglodytes aëdon* occurs in the second volume in the text to plate 107 (there are only 124 in the whole work) it could hardly have appeared before 1809." This, however, seems to be assumption without definite fact, and I do not care to abandon the long-current name *aëdon* without certain proof that such action is necessary.

Vieillot's work was projected originally to appear in four volumes but was abandoned at the close of the second, presumably because of the appearance of Wilson's work covering the same ground.

## NANNUS HIEMALIS HIEMALIS (Vieillot)

## EASTERN WINTER WREN

The only one obtained was secured 2 miles east of Ben Lomond, Mason County, on October 28.

<sup>13</sup> Ohio Journ. Sci., vol. 34, 1934, p. 90 (Gates Mills, Ohio).

## NANNUS HIEMALIS PULLUS Burleigh

## SOUTHERN WINTER WREN

A male collected at 4,860 feet on the summit of Spruce Knob on September 19 is the first State record for this recently described subspecies.<sup>14</sup> It appears that this is the resident form of the mountains of West Virginia, at least from Spruce Knob southward. It is distinguished readily from the typical winter wren (*Nannus hiemalis hiemalis*) by darker, less rufescent color above, lighter underparts, smaller bill, and slightly longer wing.

The bird from Spruce Knob has the following measurements: Wing, 48.9; tail, 30.5; culmen from base, 11.6; and tarsus, 18.2 mm.

## THRYOMANES BEWICKI BEWICKI (Audubon)

## BEWICK'S WREN

A male, and an immature bird just from the nest, come from 7 miles east of Philippi, June 3. This bird, seemingly, is becoming uncommon through much of the northern part of its range in the Eastern States.

## THRYOTHORUS LUDOVICIANUS LUDOVICIANUS (Latham)

## CAROLINA WREN

Widely distributed but only fairly common during the period of this work. One was taken near Gilboa on October 12, 1936, though none were recorded there in May. Two were secured near Barboursville on November 3, and one was collected and another seen 2 miles south of Philippi on January 2, 1937. Sight records include one near Franklin, October 1, one near Keyser, October 2, and one near McCauley, October 13, in 1935.

## CISTOTHORUS STELLARIS (Naumann)

## SHORT-BILLED MARSH WREN

A male taken near Point Pleasant on October 27 was the only one seen.

## Family MIMIDAE

## MIMUS POLYGLOTTOS POLYGLOTTOS (Linnaeus)

## EASTERN MOCKINGBIRD

Seen only near Richland on June 23.

## DUMETELLA CAROLINENSIS (Linnaeus)

## CATBIRD

This common species, distributed through the State, was obtained as follows: Wayne, May 1; hills south of the Guyandot River near Huntington, May 2; Gilboa, May 6 and 8; Freed and Big Bend,

<sup>14</sup> *Nannus hiemalis pullus* Burleigh, Proc. Biol. Soc. Washington, vol. 48, May 3, 1935, p. 61 (Mount Mitchell, N. C.).

Calhoun County, May 21; 7 miles east of Philippi, June 4; 3,500 feet on Williams River, October 7; 4,860 feet on Spruce Knob, September 18; 3,300 feet in the Cranberry Glades, May 8 and June 8 to 20; and Middle Mountain, 12 miles northeast of Durbin, June 29. The bird ranges from the lowlands through the mountains. Catbirds were present in unusual abundance during June along the south fork of the Cranberry River just below the Cranberry Glades.

**TOXOSTOMA RUFUM (Linnaeus)**

**BROWN THRASHER**

Fairly common and widely distributed. Specimens were taken as follows: Muddlety, Nicholas County, May 11; 4,700 feet elevation on Spruce Knob, September 19; 3,300 feet elevation in the Cranberry Glades, June 16; Middle Mountain, 11 miles northeast of Durbin, July 1. I saw this species at Richwood on May 9 and near Yellow Spring on May 24. One was observed on Cheat Mountain above Cheat Bridge on September 26.

**Family TURDIDAE**

**TURDUS MIGRATORIUS MIGRATORIUS Linnaeus**

**EASTERN ROBIN**

The robins of West Virginia are an interesting puzzle in allocation since both the eastern and southern forms nest in the State. In general the bird of the eastern part of the State, including the mountainous area, may be called *migratorius*, while the southern form, *achrusterus*, is found in the lower country in the central and western portions.

The typical eastern bird (*T. m. migratorius*) is richer brown below, and darker above, with the crown distinctly blackish, marked sharply from the gray of the hindneck. It is also larger, the wing ranging to more than 130 mm in length.

A male from Charmco, east of Rainelle, at an elevation of 2,200 feet (wing, 130 mm), May 8, in size and color is definitely the typical bird. A male (wing, 131 mm), taken by A. H. Howell at Beckley, Raleigh County, July 17, 1909, also is typical. Two males from Cheat Mountain, 3 and 5 miles west of Cheat Bridge, June 24 and 25 (the latter taken at 4,000 feet), have the rich, dark color of *migratorius*, though a little small (wing, 127 and 128 mm). Two males from 3,300 and 3,700 feet in the Cranberry Glades taken June 12 and 16 are definitely of the *migratorius* type, being dark in color and large (wing, 130.5 and 133 mm). A female taken there at 3,300 feet on June 16 is intermediate, as it agrees in color with *migratorius* but has the dimensions of *achrusterus* (wing, 121.7 mm). Another female, from Middle Mountain, 11 miles northeast of Durbin, July 1, is likewise intermediate, resembling the one just mentioned in size (wing, 121 mm) but is slightly

darker above. A female from Rich Mountain, 7 miles southwest of Harman, July 7, is likewise intermediate, being paler in color and somewhat larger (wing, 125 mm). A male from Red Creek, Tucker County, July 7 (wing, 133.5 mm) is large and dark. Another male from 5 miles north of Moorefield on the South Branch of the Potomac River, June 5, 1935 (wing, 129 mm) is also typical *migratorius*.

From this series it might appear that in the eastern mountainous sections male robins have the typical characters of *migratorius*, while females tend to be intermediate.

Birds in first or juvenal plumage were secured on Cheat Mountain, 3 miles west of Cheat Bridge, on June 24, and at Red Creek, Tucker County, on July 6.

In fall specimens assigned to the typical race were taken as follows: 3,000 feet elevation above Williams River, October 3; 4,860 feet elevation on Spruce Knob, September 22; 3,900 feet on Smoke Camp Mountain, 3 miles east of Thornwood, September 28; 3,000 feet elevation on Flat Top Mountain, near Flat Top, October 15 and 20; and Orgas, Boone County, October 24.

#### TURDUS MIGRATORIUS ACHRUSTERUS (Batchelder)

##### SOUTHERN ROBIN

This race is characterized by smaller size and paler color. A female taken 4 miles east of Huntington on April 24, with a wing measurement of 121 mm, is definitely this race and is assumed to be of the breeding form of that area; a male secured at the same place is dark and agrees so well with true *migratorius* that it is identified as that form, with the assumption that it is a bird in migration to other breeding grounds. Birds from Muddlety in Nicholas County, May 11, are definitely *achrusterus*. A female from Walker, Wirt County, May 22, with a wing measurement of 126 mm, verges in color toward true *migratorius*, as does a male from White Pine, Calhoun County, May 25, with a wing of 126 mm. Though intermediate these two seem nearer *achrusterus*. A male taken 7 miles east of Philippi, Barbour County, June 1, with the wing 124 mm, seems to be definitely *achrusterus*. In fall a female was taken at 3,000 feet on Flat Top Mountain near Flat Top, October 20, evidently a migrant.

#### HYLOCICHLA MUSTELINA (Gmelin)

##### WOOD THRUSH

A common species observed in woodlands throughout the State. Specimens were collected as follows: 5 miles east of Huntington, April 23; Tyler Creek, April 27; Muddlety, May 11; Persinger, Nicholas County, May 16; Grantsville, May 26; 3,300 feet elevation, Cranberry Glades, June 12; Middle Mountain, 11 to 15 miles north-east of Dublin, July 1, 2, and 3; and Thornwood, September 28.

*HYLOCICHLA GUTTATA FAXONI* Bangs and Penard

## EASTERN HERMIT THRUSH

Common and widely distributed in migration, as indicated by the following specimens: 2 miles east of White Sulphur Springs, April 18; 5 miles east of Huntington, April 20; 12 miles north of Logan, April 22; Zela, May 7; Gilboa, October 12; Orgas, Boone County, October 24; and 3,500 feet on Williams River, October 8. A female was collected at 3,300 feet in the Cranberry Glades on June 11, marking a breeding record at this point.

*HYLOCICHLA USTULATA SWAINSONI* (Tschudi)

## OLIVE-BACKED THRUSH

In migration this widely distributed bird was taken on Pine Creek near Enon on May 8; at 3,800 feet on Cheat Mountain above Cheat Bridge, September 26; at 4,600 feet on Spruce Knob, September 22; and at 3,000 feet on Williams River, Pocahontas County, October 3. A female was taken on Cheat Mountain 3 miles west of Cheat Bridge on June 24, indicating that this thrush breeds in that locality. One was seen in the Cranberry Glades on May 9, but at this date it may have been a migrant individual.

*HYLOCICHLA MINIMA ALICIAE* (Baird)

## GRAY-CHEEKED THRUSH

An immature male was taken at an elevation of 3,500 feet on Williams River in Pocahontas County, October 8. The wing measures 107.5 mm.

*HYLOCICHLA FUSCESCENS FUSCESCENS* (Stephens)

## VEERY

In spring one was taken at Fourteen, April 28. During summer one male was secured on Cheat Mountain, 5 miles northwest of Cheat Bridge, June 26, and another on Middle Mountain 11 miles northeast of Durbin, July 2. These thrushes are fairly common through the mountain area but are shy and difficult to see.

*SIALIA SIALIS SIALIS* (Linnaeus)

## EASTERN BLUEBIRD

Distributed universally through the State. Specimens were taken at the following localities; Ashton, October 31; Barboursville, November 3; Mercers Bottom, November 2; Orgas, October 24; Gilboa, Nicholas County, May 15 and October 12; Grantsville, May 20; Philippi, June 1 and 2; 3,300 feet elevation in the Cranberry Glades, June 16; Middle Mountain, northeast of Durbin, June 30 and July 3 (one fully grown but in juvenal dress); and 3,000 feet elevation on Flat Top Mountain, near Flat Top, October 20.



## Family SYLVIIDAE

*POLIOPTILA CAERULEA CAERULEA* (Linnaeus)

## BLUE-GRAY GNATCATCHER

Specimens were secured as follows: 5 miles east of Huntington, April 20; 12 miles north of Logan, April 22; Fourteen, April 29; Tyler Creek, April 27; Grantsville, May 20. Apparently this bird is common in the hilly regions of the western part of the State. Details of its distribution will be worked out slowly since it is so small that when leaves are fully grown in summer it is seen in the trees only with difficulty.

*REGULUS SATRAPA SATRAPA* Lichtenstein

## EASTERN GOLDEN-CROWNED KINGLET

The only specimens taken were secured near White Sulphur Springs. Two were collected 2 miles east on April 18, and two others at 3,000 feet elevation on Katis Mountain on November 6. I saw others near Cheat Bridge on October 1, and one near McCauley on October 13, 1935. One was seen at high altitude in the Cranberry Glades on June 20.

*CORTHYLIO CALENDULA CALENDULA* (Linnaeus)

## EASTERN RUBY-CROWNED KINGLET

Distributed in migration throughout the State and obtained as follows: White Sulphur Springs, April 18 and November 6; 5 miles east of Huntington, April 20; Dunlow, April 23; Mill Creek, 9 miles east of Huntington, April 25; 3,000 feet elevation on Williams River, October 3; 4,700 feet elevation on Spruce Knob, September 24; 2,900 feet elevation on Flat Top Mountain near Ghent, Raleigh County, October 14. One male from Dunlow, obtained April 23, has the crown patch zinc-orange instead of the usual red.

## Family BOMBYCILLIDAE

*BOMBYCILLA CEDRORUM* Vieillot

## CEDAR WAXWING

The cedar waxwing, though reduced in numbers about Washington, D. C., in recent years, remains a common bird in West Virginia. Specimens were obtained as follows: Orgas, Boone County, June 24; 2 miles west of Barboursville, Cabell County, October 26; 3 miles north of Point Pleasant, Mason County, October 27; 5 miles north of Drennen, Nicholas County, May 18; 5 and 7 miles east of Philippi, May 28, and June 1 and 4; 3,200 feet elevation on Flat Top Mountain, near Flat Top, October 15; Middle Mountain, 12 and 15 miles north-east of Durbin, June 29 and July 3; 3,300 feet elevation in the Cranberry Glades, June 9 and 12.

## Family LANIIDAE

LANIUS LUDOVICIANUS MIGRANS Palmer

## MIGRANT SHRIKE

The two taken are both females, coming from Barboursville, October 26, and Mercers Bottom, October 30. In addition, I obtained another female 5 miles west of Romney on January 3, 1937, and recorded a bird that was not collected near Pansy on January 1.

## Family VIREONIDAE

VIREO GRISEUS GRISEUS (Boddaert)

## WHITE-EYED VIREO

Taken at Fourteen, April 29; south of the Guyandot River, near Huntington, May 2; and near Persinger in Nicholas County, May 16.

VIREO FLAVIFRONS Vieillot

## YELLOW-THROATED VIREO

Apparently widely distributed but of scattered occurrence, the yellow-throated vireo was recorded as follows: Near Dunlow, April 23; Tyler Creek, April 27; Gilboa, May 5 and 6; and Zela, May 7. It is probable that all these were migrants.

VIREO SOLITARIUS SOLITARIUS (Wilson)

## BLUE-HEADED VIREO

The wing of a female secured on Peters Creek, near Gilboa, May 5, measures 72.5 mm, and the culmen from base 11.8 mm. The bill is a little large, but the bird agrees best with the typical form. Two others were taken in fall migration. A male secured 4 miles northwest of Gilboa, October 12, has the wing 76.3, and the culmen from base 11.9 mm, being somewhat large, but having the brighter green of the back of the typical form. Another male taken at an elevation of 1,800 feet near Posey, Raleigh County, October 23, measures as follows: Wing, 74.5; and culmen from base, 11.0 mm.

The shade of green on the back in these birds seems to change definitely with storage in collections. Freshly taken birds appear much brighter in color.

VIREO SOLITARIUS ALTICOLA Brewster

## MOUNTAIN VIREO

This race of the blue-headed vireo nests commonly in the higher mountains of the State. Three were taken at the Cranberry Glades on June 13 and 17. On Cheat Mountain above Cheat Bridge they were common from June 23 to 27. A young one recently from the nest was secured here on June 26, and birds were taken in fall on

September 25 and 26. Others were secured in fall near the summit of Spruce Knob on September 22, and at elevations of 3,000 to 3,500 feet on Williams River from October 3 to 8. A male taken June 17 in the Cranberry Glades has an irregular patch of white and scattered feathers of the same color in the crown. A. H. Howell collected males at Marshes on July 20, 1909, and at Mabscott on July 24, both in Raleigh County.

This race differs from the typical form in having the back with more gray, and the green slightly darker, in longer wing on the average, and in somewhat larger bill. Following are measurements from birds taken in West Virginia:

Eleven males: Wing, 74.8–80.4; tail, 50.7–56.2; culmen from base, 12.2–13.4; tarsus, 18.0–19.4 mm.

Five females: Wing, 74.6–77.9; tail, 52.0–54.5; culmen from base, 11.3–12.3; tarsus, 18.0–19.1 mm.

**VIREO OLIVACEUS (Linnaeus)**

**RED-EYED VIREO**

Of universal distribution during summer throughout the State; recorded as follows: Fourteen, April 28; Wayne, May 1; south of Guyandot River near Huntington, May 2; Zela, May 7; Pine Creek, near Enon, May 8; Freed, Calhoun County, May 21; Grantsville, May 26; near Philippi, May 31 and June 1; Rich Mountain, 7 miles southwest of Harman, July 7; 4,800 feet elevation on Spruce Knob, September 19; Cranberry Glades at 3,300 feet, June 15 and 3,800 feet, June 19; 4,000 feet elevation on Cheat Mountain, 5 miles northwest of Cheat Bridge, June 25 and 27.

**Family COMPSOTHTYPIIDAE**

**MNIOTILTA VARIA (Linnaeus)**

**BLACK AND WHITE WARBLER**

Obtained 2 miles east of White Sulphur Springs on April 18; at Mill Creek, 9 miles east of Huntington, April 25; Muddlety, May 11; 5 miles east of Philippi, May 28; and at 3,500 feet elevation on Williams River, October 8. I have seen it also near Wardensville, July 21, 1935, and in the Cranberry Glades, May 9, 1936.

**LIMNOTHTYPIUS SWAINSONI (Audubon)**

**SWAINSON'S WARBLER**

A male was taken near Fourteen in southwestern Lincoln County on April 28. It was found on the ground at the swampy border of a little stream, and until in the hand was thought to be a water-thrush. The only other record for the State known to me is that of Earle A.

Brooks<sup>15</sup> who reports "one taken by P. C. Bibbee on Cheat River, June 14, 1924."

*VERMIVORA CHRYSOPTERA* (Linnaeus)

GOLDEN-WINGED WARBLER

Breeding at 3,300 feet elevation in the Cranberry Glades, where a male was taken May 9 and a female June 16.

*VERMIVORA PEREGRINA* (Wilson)

TENNESSEE WARBLER

One was taken at 4,800 feet on Spruce Knob, September 19, and one near Ben Lomond, Mason County, October 28.

*VERMIVORA RUFICAPILLA RUFICAPILLA* (Wilson)

NASHVILLE WARBLER

A male was collected at Tyler Creek, April 27, and another at 3,100 feet on Williams River, October 2.

*COMPSOTHLYPIS AMERICANA PUSILLA* (Wilson)

NORTHERN PARULA WARBLER

A male taken at Fourteen, Lincoln County, April 27, has a wing measurement of 60.2 mm, and another from Gilboa, May 6, one of 57.0 mm.

*DENDROICA AESTIVA AESTIVA* (Gmelin)

EASTERN YELLOW WARBLER

Taken on Peters Creek near Gilboa, May 5, and on Pine Creek near Enon, May 8. A pair was observed nesting at Gilboa on May 9.

*DENDROICA MAGNOLIA* (Wilson)

MAGNOLIA WARBLER

This handsome bird was found in migration 5 miles north of Drennen, Nicholas County, May 18, and at 4,800 feet on Spruce Knob, September 19. In summer it was taken on Cheat Mountain, 3 miles west of Cheat Bridge, June 23; on Middle Mountain, 12 miles north-east of Durbin, June 27 and 29; and at elevations of 3,300 to 3,700 in the Cranberry Glades, May 9 and June 8, 9, and 15.

*DENDROICA TIGRINA* (Gmelin)

CAPE MAY WARBLER

Common on the summit of Spruce Knob from 4,600 to 4,800 feet, September 19 to 22. Two were taken at 3,500 feet on Williams River, October 8 and 9.

<sup>15</sup> West Virginia Encyc., 1929, p. 72.

## DENDROICA CAERULESCENS CAERULESCENS (Gmelin)

## BLACK-THROATED BLUE WARBLER

Found in migration at 3,300 feet elevation in the Cranberry Glades on May 9; on Cheat Mountain, 3 miles west of Cheat Bridge, September 26; at 3,900 feet on Smoke Camp Mountain, 3 miles east of Thornwood, September 28; at 4,600 to 4,700 feet on Spruce Knob, September 22 and 24; and at 3,500 feet on Williams River, October 7.

## DENDROICA CAERULESCENS CAIRNSI Coates

## CAIRNS'S WARBLER

On the summit of Cheat Mountain west of Cheat Bridge this warbler was common from June 23 to 26, and one was taken here on September 25. A male was secured on Middle Mountain, 12 miles northeast of Durbin, June 29, and two were obtained at 3,300 feet in the Cranberry Glades, June 15 and 18. On July 6 and 7 birds were collected on Rich Mountain from 6 to 7 miles southwest of Harman. The last recorded in fall was a male secured at 3,500 feet on Williams River on October 7. A. H. Howell obtained one at Dry Creek on July 22, 1909.

This series indicates that Cairns's warbler is more different from the typical black-throated blue than I had supposed from examination of material from the mountains of western Maryland. Males are distinctly deeper blue in color above, ordinarily with more black in the dorsum, though this does not always hold. Females are distinctly darker above both in summer and in fall dress.

## DENDROICA CORONATA CORONATA (Linnaeus)

## MYRTLE WARBLER

Obtained in spring 12 miles north of Logan on April 22, and at Tyler Creek on April 27. In fall specimens were taken at 2,900 feet on Flat Top Mountain, near Flat Top on October 19, at 2,100 feet on Cherry Pond Mountain near Arnett on October 22, and near Orgas on October 24.

The western race of the myrtle warbler, *Dendroica coronata hooveri*, I consider valid. If this is accepted then the name of the eastern bird is *Dendroica coronata coronata*.

## DENDROICA VIRENS VIRENS (Gmelin)

## BLACK-THROATED GREEN WARBLER

In spring this common warbler was taken 2 miles east of White Sulphur Springs, April 18; 12 miles north of Logan, April 22; near Dunlow, April 23; near Fourteen, April 28; and near Zela, May 7. Breeding specimens were secured on Cheat Mountain, 3 miles west of

Cheat Bridge, June 24; on Rich Mountain, 7 miles southwest of Harman, July 7; and in the Cranberry Glades, June 11 and 20. I saw them in the latter locality on May 9. One was observed on Middle Mountain July 3. In fall these birds were found on Williams River at 3,100 feet elevation on October 2; at 4,600 feet on Spruce Knob, September 22; and on Flat Top Mountain, near Odd, October 17. There is a juvenile specimen in the Biological Survey collection taken on July 22, 1909, at Dry Creek by A. H. Howell.

*DENDROICA CERULEA* (Wilson)

CERULEAN WARBLER

One male was taken at Fourteen, April 27, and two were secured on Pine Creek, near Enon, May 8.

*DENDROICA FUSCA* (Müller)

BLACKBURNIAN WARBLER

One was taken on Spruce Knob on September 22 and one was seen on Pine Creek, near Enon, on May 8.

*DENDROICA PENNSYLVANICA* (Linnaeus)

CHESTNUT-SIDED WARBLER

Taken at Huntington on May 2; on Cheat Mountain, 5 miles northwest of Cheat Bridge, June 25; on Middle Mountain, 11 miles northeast of Durbin, July 2; and at 3,300 feet in the Cranberry Glades, May 9 and June 20. In this last locality on May 9 this was the most abundant warbler, being found in pairs that were preparing to nest. The species was recorded on Middle Mountain on July 3.

*DENDROICA CASTANEA* (Wilson)

BAY-BREASTED WARBLER

Taken at 3,800 feet on Cheat Mountain, 3 miles west of Cheat Bridge, September 25 and 26; at the Cranberry Glades, May 9; and at 3,000 to 3,300 feet on Williams River, October 2, 3, and 5, the last coming from Little Spruce Mountain.

*DENDROICA STRIATA* (Forster)

BLACK-POLL WARBLER

One was taken at 4,800 feet on Spruce Knob on September 21, and one at 3,100 feet on Williams River on October 2. I observed this species near McCauley on October 13, 1935.

*DENDROICA DISCOLOR DISCOLOR* (Vieillot)

NORTHERN PRAIRIE WARBLER

Found 5 miles east of Huntington, April 21 and 22; near Mill Creek, 9 miles east of Huntington, April 25; and at Fourteen, April 27.

*DENDROICA PALMARUM PALMARUM* (Gmelin)

## WESTERN PALM WARBLER

Two were collected on Flat Top Mountain, one near Ghent, October 14, and one near Flat Top, October 20.

The Rev. E. A. Brooks<sup>18</sup> records only the yellow palm warbler from the State. The two listed above are typical of the western form.

*SEIURUS AUROCAPILLUS* (Linnaeus)

## OVEN-BIRD

Common and widely distributed and collected as follows: Tyler Creek, April 27; Zela, May 7; Enon, May 8; Cranberry Glades, June 9 and 15; 4,000 feet elevation on Cheat Mountain, 5 miles north-west of Cheat Bridge, June 25; Cranberry Glades, June 9 and 15; 4,800 feet elevation on Spruce Knob, September 21.

*SEIURUS NOVEBORACENSIS NOVEBORACENSIS* (Gmelin)

## NORTHERN WATER-THRUSH

This bird was observed at 3,300 feet in the Cranberry Glades on May 9. It breeds there, as three specimens, including two males and a female, were secured on June 10.

*SEIURUS MOTACILLA* (Vieillot)

## LOUISIANA WATER-THRUSH

Taken near Dunlow, April 23; 4 miles east of Huntington, April 24; near Persinger, Nicholas County, May 16; and 5 miles east of Philippi, May 29. On July 21, 1935, I recorded one near Baker City. On April 19, 1936, I located a pair along a small brook running along a valley on Short Mountain, near McCauley. On May 24 this stream was dry, and the birds flew continually down to Lost River a short distance below and then returned, apparently to secure food for their young.

*OPORORNIS FORMOSUS* (Wilson)

## KENTUCKY WARBLER

A locally common species that was obtained at Fourteen, April 29; at Gilboa, May 5; and near Smithville, Ritchie County, May 22. I observed it near Lost River in the vicinity of McCauley on May 24.

*OPORORNIS PHILADELPHIA* (Wilson)

## MOURNING WARBLER

An adult female was taken in the Cranberry Glades on June 20.

<sup>18</sup> West Virginia Encycl., 1929, p. 72.

## GEOTHELYPIS TRICHAS TRICHAS (Linnaeus)

## MARYLAND YELLOW-THROAT

An immature male taken at the summit of Spruce Knob on September 18 is of this race, as indicated by its wing measurement of 52.8 mm and by its dull coloration both above and below. It is evidently a migrant in this locality.

It is assumed that this is the breeding bird of extreme eastern West Virginia, in the section east of the mountains, though specimens need to be collected to establish this.

## GEOTHELYPIS TRICHAS BRACHIDACTYLA (Swainson)

## NORTHERN YELLOW-THROAT

Careful study of specimens indicate that this is the yellow-throat that nests through the mountain area and the hill section to the west, as well as in the northwestern portion. Whether true *trichas* is found in the southwestern part of the State as a breeding bird remains to be ascertained, as the only specimen at hand, from Fourteen, taken April 28, is *brachidactyla*, though at that date it may have been a migrant individual. One was taken at Zela, May 7; one at Grantsville, May 20; one at Freed, Calhoun County, May 21; and one at White Pine, May 25. In three males the wing ranges from 56.2 to 56.3 and the exposed culmen from 11.2 to 12.3 mm; and in two females the wing is 52.0 and 54.7 and the exposed culmen 11.8 and 12.0 mm.

In the mountains breeding specimens were taken in the Cranberry Glades, on May 9 and between June 9 and 20, and on Middle Mountain 12 miles northeast of Durbin, June 29. Males have the wing 54.3 to 56.2 mm and the culmen from base 12.5 to 12.8 mm. Females have the wing 49.3 to 51.7 and the culmen from base 11.4 to 11.7 mm.

Fall specimens include a female from Cheat Mountain, 3 miles west of Cheat Bridge, September 26 (wing, 52.3; culmen from base, 11.4 mm), and a pair from Spruce Knob, September 18 and 21 (male, wing 56.2, culmen from base 12.5 mm; female, wing 52.0, culmen from base 11.2 mm).

All these specimens are brighter green above and more extensively yellow below when compared with typical *trichas*, the colors being especially rich in fall plumage.

This marks a definite southern extension of the range of the northern yellow-throat from what is given in the fourth edition of the A. O. U. Check-list of North American Birds, 1931, p. 296.

## ICTERIA VIRENS VIRENS (Linnaeus)

## YELLOW-BREASTED CHAT

A common bird that is difficult to find. Specimens were taken at Fourteen, April 28; Zela, May 7; Persinger, May 16; Grantsville,



May 20; and Walker, May 22. I secured one near Wardensville on July 21, 1935, and in 1936 I observed it at Gilboa on May 9; Cranberry Glades, May 9; and on Short Mountain near McCauley, May 24.

*WILSONIA CITRINA* (Boddaert)

HOODED WARBLER

Specimens were taken by Perrygo and Lingebach at Tyler Creek, April 27; 5 miles north of Drennen, May 18; and 7 miles east of Philippi, June 4. I secured a female near McCauley, May 24.

*WILSONIA CANADENSIS* (Linnaeus)

CANADA WARBLER

In migration one was collected on Pine Creek, near Enon, May 8, and another near Wayne, May 1. A common summer resident in the mountains, found on Middle Mountain (including Yokum Knob) 11 to 15 miles northeast of Durbin, June 29 to July 4, and in the Cranberry Glades, May 9 and June 9 to 15.

*SETOPHAGA RUTICILLA* (Linnaeus)

REDSTART

A common resident that was collected as follows: Near Dunlow, April 23; Fourteen, April 27; Gilboa, May 5 and 6; Enon, May 8; Mt. Zion, Calhoun County, May 23; 5 miles east of Philippi, May 28.

Family PLOCEIDAE

*PASSER DOMESTICUS DOMESTICUS* (Linnaeus)

ENGLISH SPARROW

Two were taken 4 miles east of Huntington on April 24. Distributed about towns and farms throughout the State.

Family ICTERIDAE

*STURNELLA MAGNA MAGNA* (Linnaeus)

EASTERN MEADOWLARK

Distributed throughout the State in open fields and meadows. Specimens were taken as follows: Mercers Bottom, October 29; Gilboa, October 26; Muddlety, May 11; Grantsville, May 26; and near Yokum Knob, on Middle Mountain, July 4. In the mountains they occur only in extensive meadows, such as the Big Burn near Yokum Knob. Here they were fairly common. In four males the wing ranges from 118.2 to 122.0 mm, and in three females from 105.8 to 109.0 mm. In size and color these birds agree with the typical form.

In addition to the localities cited I have recorded these birds as follows: Near Moorefield, June 5, 1935; Mathias, July 4, 1935; and Wardensville, July 21 and October 13, 1935.

*AGELAIUS PHOENICEUS PHOENICEUS* (Linnaeus)

EASTERN RED-WING

The red-wing is widely distributed through West Virginia along the borders of streams in open country. It is found usually in scattered groups of one to three or four pairs, being less abundant numerically than in areas where there are more extensive marshes. It has a wide altitudinal range, as breeding birds were taken near Muddlety in Nicholas County, May 11, 12, and 14; 5 miles east of Philippi, May 30; and at 3,300 feet elevation in the Cranberry Glades, June 16. Migrants were secured near Ashton on October 31.

Wing measurements in males range from 116.3 to 120.9 mm, and in females from 97.4 to 102.0 mm.

*AGELAIUS PHOENICEUS ARCTOLEGUS* Oberholser

GIANT RED-WING

It was a distinct surprise to find in the small series of red-winged blackbirds a fine specimen of this race taken near Enon, Nicholas County, on May 11, 1936. The bird is a male in full adult plumage, with the following measurements: Wing, 129.2; tail, 94.6; culmen from base, 24.0; and tarsus, 31.3 mm. It is of interest to compare the perfect plumage of this bird with the worn wing and tail feathers of skins of the resident race taken at the same time near Muddlety only a few miles away. This seems to be the first record of this northern migrant for the State.

*ICTERUS SPURIUS* (Linnaeus)

ORCHARD ORIOLE

One was seen near Grantsville on May 20, and I observed this species at Moorefield on June 5, 1936.

*ICTERUS GALBULA* (Linnaeus)

BALTIMORE ORIOLE

I saw this bird in Summersville on May 9, and one was collected at Mount Zion, Calhoun County on May 23.

*EUPHAGUS CAROLINUS* (Muller)

RUSTY BLACKBIRD

The only two seen were taken October 30 near Mercers Bottom, one being prepared as a skeleton.

*QUISCALUS QUISCULA AENEAS* Ridgway

## BRONZED GRACKLE

The only specimen taken is a young male recently from the nest from near Richland, Greenbrier County, June 24. Its identification is based on assumption, since it is entirely in juvenal plumage. It is dark in color and shows indistinct streakings of dusky on the gray brown of the breast and abdomen.

Grackles are local during the nesting season, and no adults were taken though special search was made for them. I saw a few near Enon on May 9.

*MOLOTHRUS ATER ATER* (Boddaert)

## EASTERN COWBIRD

Found in summer mainly, if not entirely, west of the mountains. Following are localities at which specimens were taken: Near Huntington (including a point 4 miles east, and another in the hills south of the Guyandot River), April 25 and May 2; Muddlety, May 14; 5 miles north of Drennen, May 18; West Fork River, near Arnoldsburg, Calhoun County, May 23; Laurel Creek near White Pine, May 25; and 7 miles east of Philippi, June 1. On April 19 I observed several flocks in migration near McCauley.

## Family THRAUPIDAE

*PIRANGA ERYTHROMELAS* Vieillot

## SCARLET TANAGER

Common and widely distributed wherever there is woodland. Specimens were taken as follows: Fourteen, April 28; Gilboa, May 5; Enon, May 8; Wayne, May 1; Rich Mountain, 7 miles southwest of Harman, July 8; 3,300 to 3,700 feet in the Cranberry Glades, June 9 and 15; and 3,800 feet elevation on Cheat Mountain, 8 miles northwest of Cheat Bridge, September 26. Near White Sulphur Springs and Charmco I found them common on May 8, and on the following day I observed many at Gilboa and in the Cranberry Glades. Several were seen near McCauley on May 24.

*PIRANGA RUBRA RUBRA* (Linnaeus)

## SUMMER TANAGER

Two were secured in the hills south of the Guyandot River near Huntington on May 2, and another along the Little Kanawha River near Grantsville on May 20. I observed one near Barboursville on October 10, 1932.

## Family FRINGILLIDAE

*RICHMONDENA CARDINALIS CARDINALIS* (Linnaeus)

## EASTERN CARDINAL

This handsome bird is universally distributed except in the higher mountains of the State. A male secured at 3,500 feet elevation on

Williams River marks the highest altitude at which it was encountered. It was also found 7 miles east of Philippi on June 2. In the western section of the State it was common, being recorded as follows: 5 miles east of Huntington, April 20; 12 miles north of Logan, April 22; near Dunlow, April 23; Gilboa, where it was common, May 15; Orgas, Boone County, October 24; Barboursville, October 26; Mercers Bottom, October 29; Ben Lomond, October 28; Point Pleasant, October 27; Big Springs, Calhoun County, May 22; West Fork River near Rocksdales and Arnoldsburg, May 23.

**HEDYMELES LUDOVICIANUS (Linnaeus)**

**ROSE-BREADED GROSBILL**

Collected as follows: Wayne, May 1; Enon, May 8; summit of Cheat Mountain, 5 miles northwest of Cheat Bridge, June 27; Middle Mountain, 11 miles northwest of Durbin, July 2; Cranberry Glades, June 18 and 20; 4,800 feet elevation on Spruce Knob, September 21; 3,000 feet elevation on Williams River, October 3.

**PASSERINA CYANEA (Linnaeus)**

**INDIGO BUNTING**

Obtained at the following points: Little Kanawha River near Grantsville, May 20; Big Bend, May 21; Macfarlan, Ritchie County, May 22; Walker, Wirt County, May 22; West Fork River near Arnoldsburg, May 23; 5 miles west of Grantsville, May 26; 7 miles east of Philippi, June 4; Cranberry Glades, June 12 and 15 (the latter including one bird just from the nest); and 7 miles south of Harman, July 8.

**CARPODACUS PURPUREUS PURPUREUS (Gmelin)**

**EASTERN PURPLE FINCH**

Two migrant males in full color and a female were taken 5 miles east of Huntington on April 20 and 21. More interesting is a male in dull dress with plumage considerably worn secured at high altitude in the Cranberry Glades on June 20. A dozen pairs were found on this day over rough, stony slopes, where they were approached with difficulty. This represents a considerable southern extension of summer range from the former known limit in western Maryland. Two were observed on Spruce Knob on September 18.

**SPINUS PINUS PINUS (Wilson)**

**NORTHERN PINE SISKIN**

One specimen was taken from a little flock at 3,000 feet on Katis Mountain near White Sulphur Springs on November 6.

## SPINUS TRISTIS TRISTIS (Linnaeus)

## EASTERN GOLDFINCH

A common, widely distributed bird of which records were made as follows: 5 miles east of Huntington, April 21; Huntington, April 29; 2 miles west of Barboursville, October 26; Mercers Bottom, October 29; Gilboa, May 5; Enon, May 8; 5 miles east of Philippi, May 30; Little Spruce Knob on Williams River, October 5; 3,500 feet elevation on Williams River, October 7; Cranberry Glades, June 19; 3,000 feet elevation on Katis Mountain, near White Sulphur Springs, November 6.

## PIPILO ERYTHROPHthalmus ERYTHROPHthalmus (Linnaeus)

## RED-EYED TOWHEE

A species widely distributed in summer that was recorded as follows: 5 miles east of Huntington, April 20 and 21; 12 miles north of Logan, April 22; Fourteen, April 28 and 29; Zela, May 7; Enon, May 8; Mount Zion, Calhoun County, May 23; 5 miles east of Philippi, May 29; Red Creek, Tucker County, July 6; Rich Mountain, 7 miles southwest of Harman, July 7; summit of Spruce Knob, September 19 and 24; Cranberry Glades, June 8, 15, and 20; Middle Mountain, 12 miles southeast of Durbin, June 27. A young bird not fully grown was secured on Spruce Knob on September 19. This bird may possibly winter in the southwestern section near the Ohio River, as one was taken at Barboursville on November 3.

## PASSERCULUS SANDWICHENSIS SAVANNA (Wilson)

## EASTERN SAVANNAH SPARROW

Three adults taken at the Big Burn near Yokum Knob, on Middle Mountain, on July 4 constitute an extension in breeding range for this bird. They were fairly common. In fall one was taken at 3,200 feet on Flat Top Mountain, near Flat Top, October 15, and another near Mercers Bottom, October 29. On June 5, 1935, I recorded one near the South Branch of the Potomac River, five miles north of Moorefield. On October 2, 1935, I observed a number near Mount Storm, and saw others on October 13 near Lehew.

## PASSERCULUS SANDWICHENSIS LABRADORIUS Howe

## LABRADOR SAVANNAH SPARROW

An immature male taken on November 2 near Mercers Bottom is definitely darker above, with the black markings more extensive and bordered on lower back and rump with dark brown, and the breast markings reduced in number but larger, than in specimens of *P. s. savanna*. Its differences are so evident that it is identified as the Labrador form, a race whose range as yet is poorly defined, particularly in its migrations.

*AMMODRAMUS SAVANNARUM AUSTRALIS* Maynard

## EASTERN GRASSHOPPER SPARROW

Specimens were taken 7 miles east of Philippi, June 2, and near Ashton, Mason County, October 31.

*POOECETES GRAMINEUS GRAMINEUS* (Gmelin)

## EASTERN VESPER SPARROW

Through the upland section this species is widely distributed wherever there are open fields. In the western and central parts of the State it was found at Muddlety, May 13; Grantsville, May 25; and 5 miles east of Philippi, May 30. I saw many near Richwood on May 9. In fall they were found in migration at Mercers Bottom, near the Ohio River, October 30 and November 2. Breeding birds were taken on Middle Mountain, nine miles southeast of Durbin on June 30. Others, taken in fall, come from the summit of Spruce Knob, September 22 and 24; 2,100 feet elevation on Cherry Pond Mountain near Arnett, October 22; and 2,900 and 3,200 feet on Flat Top Mountain, near Flat Top, October 15 and 19. I found a nest near Moorefield on June 5, 1935, and observed that they were common from Baker City to Mathias on July 4 and at Lehew on October 13, 1935.

*CHONDESTES GRAMMACUS GRAMMACUS* (Say)

## EASTERN LARK SPARROW

A pair found 7 miles east of Philippi on June 4 were the only ones seen. The female was taken. Maurice Brooks<sup>17</sup> has recorded this bird at French Creek, Upshur County, in 1932, stating that in recent years it has become rare in the State.

*JUNCO HYEMALIS HYEMALIS* (Linnaeus)

## SLATE-COLORED JUNCO

Common as a migrant, this junco in the mountain sections mingles with the resident Carolina junco. In mixed flocks the smaller size, with the darker slate of males and the more pronounced brownish wash on back and sides in females in the present form, is ordinarily easily evident. Specimens were obtained as follows: 12 miles north of Logan, April 22; Barboursville, November 3; Mercers Bottom, October 30; Ben Lomond, October 28; 3,500 feet elevation on Williams River, October 7; 2,900 to 3,200 feet elevation on Flat Top Mountain near Flat Top, October 15 and 19; and near White Sulphur Springs April 18 and November 6 (the latter date referring to specimens taken at 3,000 feet on Katis Mountain).

<sup>17</sup> Auk, 1933, p. 121.

## JUNCO HYEMALIS CAROLINENSIS Brewster

## CAROLINA JUNCO

This resident form is restricted to the higher mountains of the eastern part of the State. It breeds mainly above 3,000 feet, descending in the valleys adjacent to the mountain bases in winter, but not moving far from the sections that are its summer home. A female was collected on Rich Mountain, 7 miles southwest of Harman, on July 7. On Williams River three were taken on October 7 at an elevation of 3,500 feet, one still showing some of the striped juvenal plumage. Two were collected on September 18 and 21 on the summit of Spruce Knob at 4,800 feet, a locality where I found them common on September 30, 1935. On the latter day I took a bird still in juvenal dress 4 miles northeast of Thornwood. On January 1, 1937, I collected one at an elevation of 2,000 feet in the narrow valley of Friends Run on the slopes of North Fork Mountain, 3 miles west of Franklin. We found them in the Cranberry Glades on May 9, and they were common here from June 9 to 20. A young bird just from the nest was taken there on June 20. On Middle Mountain, 12 miles northeast of Durbin, specimens were taken June 29, including a bird fully grown, but in juvenal dress. Others were secured on Cheat Mountain, 3 miles west of Cheat Bridge from June 23 to 25. Two were taken at 3,000 and 3,500 feet elevation on Flat Top Mountain, near Flat Top, October 15 and 20. I recorded one on April 19 on the slopes of Short Mountain near McCauley.

In life this bird seems quite distinct from the ordinary junco, appearing larger and distinctly grayer. Its field identification is ordinarily not difficult. Immature females in fall show some wash of brown on back, flanks, and under tail-coverts and have brownish edgings on the tertials and rectrices. The brown, however, is less in extent and is duller in color than in *J. h. hyemalis* in the same stage, and the gray is lighter and clearer.

## SPIZELLA ARBOREA ARBOREA (Wilson)

## EASTERN TREE SPARROW

Three were seen and one was taken near Upper Tract on January 1, 1937.

## SPIZELLA PASSERINA PASSERINA (Bechstein)

## EASTERN CHIPPING SPARROW

Collected as follows: 2 miles east of White Sulphur Springs, April 18; 5 miles east of Huntington, April 21; Mercers Bottom, October 30; Point Pleasant, October 27; Zela, May 7; Summersville, May 13; Arnoldsburg, May 23; 7 miles east of Philippi, June 1; Flanagans Hill near Elk, Tucker County, July 6; 3,000 feet elevation on Williams River, October 3; 3,300 feet elevation in the Cranberry Glades, June 12;

Orgas, Boone County, October 24; 2,100 feet elevation on Cherry Pond Mountain, near Arnett, October 22; and 2,900 feet elevation on Flat Top Mountain, near Flat Top, October 19.

*SPIZELLA PUSILLA PUSILLA* (Wilson)

EASTERN FIELD SPARROW

A bird distributed universally in the State that was obtained as follows: 4 and 5 miles east of Huntington, April 23 and 24; Tyler Creek, April 27; Mercers Bottom, October 29 and November 2; Point Pleasant, October 27; Zela, May 7; Enon, May 8; Gilboa, October 12; Muddlety, May 11 and 14; Grantsville, May 20; 3,000 to 3,500 feet elevation on Williams River, October 3, 5 and 7; Cranberry Glades, June 12 (young), and 13; Cheat Mountain, above Cheat Bridge, June 25; Flat Top Mountain, near Flat Top, October 15 and 19.

*ZONOTRICHIA LEUCOPHRYS LEUCOPHRYS* (Forster)

WHITE-CROWNED SPARROW

Found in fall migration, when three were obtained near Mercers Bottom, October 29, and one near Ashton, October 31.

*ZONOTRICHIA ALBICOLLIS* (Gmelin)

WHITE-THROATED SPARROW

A common migrant for which the following records were made: 5 miles east of Huntington, April 20; 12 miles north of Logan, April 22; Barboursville, October 26; Mercers Bottom, October 29 and 30, and November 2; Ben Lomond, October 28; Point Pleasant, October 27; Zela, May 8; 3,000 feet elevation on Williams River, October 3; Cranberry Glades, May 9 and October 2; 2,800 feet elevation on Flat Top Mountain, near Odd, October 20; 3,000 feet elevation on Katis Mountain, near White Sulphur Springs, November 6; and Wades Creek, 4 miles southeast of White Sulphur Springs, May 8.

*PASSERELLA ILIACA ILIACA* (Merrem)

EASTERN FOX SPARROW

Found in fall at Orgas, Boone County, October 24; Mercers Bottom, October 30; and at 3,000 feet elevation on Katis Mountain, near White Sulphur Springs, November 6. The last mentioned is partially albinistic, having a few white feathers in back and crown.

*MELOSPIZA LINCOLNI LINCOLNI* (Audubon)

LINCOLN'S SPARROW

Found as a migrant 5 miles north of Drennen, May 18; at 3,000 feet elevation on Williams River, October 3; and near Orgas, October 24.



## MELOSPIZA GEORGIANA (Latham)

## SWAMP SPARROW

Found during the migration period near Huntington, May 2; Barboursville, October 26; Mercers Bottom, October 30 and November 2; Ashton, October 31; 2,900 feet elevation on Flat Top Mountain, near Ghent, October 14; 2,000 feet elevation on Cherry Pond Mountain, near Arnett, October 23; Orgas, October 24; 3,800 feet elevation on Cheat Mountain, 3 miles west of Cheat Bridge, September 25; and 3,000 feet elevation on Williams River, October 3.

In the Cranberry Glades specimens were obtained on June 11 and 12. One was taken on Middle Mountain, 12 miles northeast of Durbin, on June 29, and a young bird recently from the nest was secured at Yokum Knob on Middle Mountain on July 4.

## MELOSPIZA MELODIA MELODIA (Wilson)

## EASTERN SONG SPARROW

That the true eastern song sparrow nests in extreme eastern West Virginia is indicated by a male in worn breeding plumage in the National Museum taken at Halltown on August 1, 1898. In migration this form may occur casually elsewhere, as a male collected by Perrygo and Lingeback at 2,000 feet elevation on Cherry Pond Mountain near Arnett on October 23, 1936, has the brighter color of the eastern race.

## MELOSPIZA MELODIA EUPHONIA Wetmore

## MISSISSIPPI SONG SPARROW

For several years I have examined song sparrows from localities in the eastern United States to work out the ranges of the geographic races in that area. It has been evident that breeding birds from the Allegheny Mountain section were darker in color than the typical eastern song sparrow (*Melospiza melodia melodia*), and for a time I followed W. E. Clyde Todd in calling this darker mountain race *Melospiza melodia beata* Bangs.<sup>18</sup> This name has become current for the bird of the eastern Mississippi Valley drainage in general, as it was adopted in the fourth edition of the A. O. U. Check-list of North American birds in 1931.

Last year, however, I had opportunity to see the type specimen of *beata* in the collections of the Museum of Comparative Zoölogy, and I found that it was a specimen of the Dakota song sparrow (*Melospiza melodia juddi* Bishop), migrant to winter quarters in Florida. As *beata* Bangs thus became a synonym of *juddi*, I described the breeding bird

<sup>18</sup> *Melospiza melodia beata* Bangs, Proc New Zealand Zool. Club, vol. 6, June 5, 1912, p 87 (Enterprise, Fla.).

of the West Virginia mountains as *Melospiza melodia euphonia*.<sup>19</sup> This name replaces *beata*, therefore, as given in the A. O. U. Check-list.

Breeding birds from the mountain region of West Virginia appear somewhat darker than those from the central Mississippi Valley, but it seems doubtful with material now at hand that the Allegheny Mountain birds and those from the lowlands to the westward can properly be separated. A good series of fall specimens indicates no evident differences.

To the eastward *euphonia* intergrades with *melodia*, a specimen secured on Lost River, near McCauley, W. Va., on May 24, 1936, being intermediate but nearer to *euphonia*.

This song sparrow is widely distributed from the eastern line of the mountains westward in West Virginia, as indicated by the following localities from which specimens have been examined: Barboursville, November 3; Mercers Bottom, October 29 and 30 and November 2; Ben Lomond, October 28; Ashton, October 31; Point Pleasant, October 27; Zela, May 13; Muddlety, May 14; Drennen, May 18; Big Bend, Calhoun County, May 21; Rocksdales, May 23; White Pine, June 25; 5 miles east of Philippi, May 30; 3,000 to 3,500 feet on Williams River, October 3 to 8; 4,800 feet on Spruce Knob, September 21; Cranberry Glades (the type locality), May 9 and June 8 to 12; Middle Mountain 12 miles northeast of Durbin, June 29 and July 4; Cheat Mountain, above Cheat Bridge, June 26 and September 26; 2,000 feet elevation on Cherry Pond Mountain near Arnett, October 23; Flat Top Mountain (2,900 to 3,000 feet), near Flat Top, October 19 and 20, near Odd, October 20, and near Ghent, October 14 and 20.

CALCARIUS LAPPONICUS LAPPONICUS (Linnaeus)

LAPLAND LONGSPUR

On January 1, 1937, in company with W. M. Perrygo I saw a flock of 25 longspurs circling high in the air over the open level valley of the South Fork of the Potomac River, 3 miles north of Moorefield, and collected two at long range as they passed overhead. These seem to be the first specimens taken in the State, the only other report for the species being two seen by Maurice Brooks<sup>20</sup> at Red House, Putnam County, on March 7, 1936.

<sup>19</sup> *Melospiza melodia euphonia* Wetmore, Smithsonian Misc. Coll., vol. 95, no. 17, Sept. 26, 1936, p. 1 (3,300 feet elevation, Cranberry Glades, Pocahontas County, W. Va.).

<sup>20</sup> Auk, 1936, p. 454.



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## ANNOTATED LIST OF WEST VIRGINIA MAMMALS

By REMINGTON KELLOGG

*Assistant Curator, Division of Mammals, United States National Museum*

IN THE spring of 1936 the Smithsonian Institution completed arrangements for a party from the United States National Museum to make a collection of birds and mammals in West Virginia. In accordance with instructions I accompanied the party across the State to Cabell County, where a camp was established about 4 miles east of Huntington on April 19, 1936. After making a number of short trips along the stream valleys of adjoining counties to appraise collecting prospects, I returned to Washington, D. C., on April 25. Watson M. Perrygo and Carleton Lingebach continued with the work until July 9 and then returned to Washington. On September 16 they went again to West Virginia and remained there until November 7.

Included in this report are all the West Virginia specimens in the National Museum and the Biological Survey collections. Seventy-three forms of Recent mammals are recorded as present either now or formerly within the boundaries of the State.

Measurements herein are given in millimeters.

The collectors of the specimens herein discussed are listed as follows chronologically according to the year in which the material was obtained:

## U. S. NATIONAL MUSEUM

Spencer F. Baird, 1850.  
 C. B. R. Kennerly, 1850.  
 A. Brakeley, 1856, 1857.  
 Gustave Kohn, 1886.  
 Mrs. C. Hart Merriam, 1888.  
 Wirt Robinson, 1896, 1897.  
 Thaddeus Surber, 1896, 1897.  
 J. H. Riley, 1899.  
 W. P. Hay, 1900.  
 Lee Hiett, 1900.  
 Isaac Helmick, 1905.  
 J. R. Godlove, 1911.  
 C. Worthington, 1916.  
 B. L. Chambers, 1924.  
 A. B. Brooks, 1928.  
 W. J. Hamilton, Jr., 1931.  
 A. M. Reese, 1933, 1936.  
 Andrew W. Alt, 1935.  
 Remington Kellogg, 1936.  
 Carleton Lingeback, 1936.  
 W. M. Perrygo, 1936.

## U. S. BIOLOGICAL SURVEY

J. D. Figgins, 1890.  
 Richard Elkins, 1892.  
 E. B. Vaughan, 1892.  
 R. S. Matthews, 1895.  
 E. A. Preble, 1895, 1909.  
 Vernon Bailey, 1897, 1924, 1928.  
 C. G. Rorebeck, 1897.  
 W. J. Yeager, 1897, 1902.  
 T. B. Wilson, 1903.  
 J. L. Yost, 1907, 1908.  
 Fred E. Brooks, 1909.  
 Arthur H. Howell, 1909, 1910.  
 Frank Houchin, 1910.  
 B. L. Yost, 1910.  
 Mrs. T. H. Ward, 1915.  
 A. B. Brooks, 1916.  
 James Silver, 1921.

## Family DIDELPHIIDAE

## DIDELPHIS VIRGINIANA VIRGINIANA Kerr

## OPOSSUM

Opossums are seldom found very far away from timbered bottom lands, ravines, or rock ledges on bluffs and hillsides. They occur less frequently in dry upland woods. They are chiefly nocturnal. During the day they hide in abandoned woodchuck burrows, under roots of trees, in hollow logs, in crevices in rock ledges, or in old nests made of leaves by gray squirrels. Two opossums were trapped in Cabell County during the latter part of April 1936. One of these was a large female that had 11 young in the pouch, ranging from 26 to 28 mm in length. During the winter of 1908-09, two were killed by Frank Houchin at Cranberry Glades, Pocahontas County (F. E. Brooks, 1911, p. 11), indicating that their vertical range goes at least to 3,300 feet. They are occasionally killed by automobiles on the highways. One thus killed was seen near Summersville during October 1936.

Cabell County: 3 miles east of Huntington, 2.

## Family TALPIDAE

## PARASCALOPS BREWERI (Bachman)

## HAIRY-TAILED MOLE

Available records indicate that the hairy-tailed mole occurs throughout the eastern mountainous portion of the State as well as along the Ohio drainage in the western part. It has not as yet been reported

from the central and southern portions of West Virginia. The tunnels made by this mole are frequently injurious to lawns and flower beds.

**Cabell County:** 4 miles east of Huntington, 2.

**Greenbrier County:** White Sulphur Springs, 3.

**Lincoln County:** Mountains between Fourteen and Guyandotte River, 1.

**Ohio County:** Oglebay Park near Wheeling, 1.

**Pendleton County:** Franklin, 1.

**Pocahontas County:** Cranberry Glades, 1; Travellers Repose, 1.

**Randolph County:** Cheat Bridge, altitude 3,558 feet, 1.

**Wetzel County:** 1.

#### SCALOPUS AQUATICUS AQUATICUS (Linnaeus)

##### EASTERN MOLE

On July 4, 1895, a male of this animal was found dead by R. S. Matthews in a road on the side of a mountain in one of the northeastern counties. Subsequent collecting has not revealed any further information on its distribution within the State.

**Morgan County:** Berkeley Springs, 1.

#### CONDYLURA CRISTATA (Linnaeus)

##### STAR-NOSED MOLE

The star-nosed mole is an inhabitant of wet meadows, marshes, and bogs in eastern and northern West Virginia. In June 1908, F. E. Brooks (1911, p. 29) collected one on the bank of Big Run, Pendleton County, and another near Osceola, Randolph County. A. B. Brooks (1929, p. 539) recorded one from Deckers Creek, Monongalia County. The National Museum party trapped one on June 18, 1936, in a runway in moss covering the wet soil of Cranberry Glades.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 1.

#### Family SORICIDAE

##### SOREX CINEREUS CINEREUS Kerr

##### CINEREOUS SHREW

This small shrew seems to be commonest in the bogs and forests in the eastern mountainous portion of the State. It has been recorded (A. B. Brooks, 1929, p. 540) from Oglebay Park, Ohio County, as well as from French Creek, Upshur County, and Pickens, Randolph County (Fred E. Brooks, 1911, p. 27). It was most frequently trapped by Perrygo and Lingebach under the matted leaves on the hillsides about 30 to 40 yards from streams. The traps were set in the runways that were exposed when the leaves were pushed aside. In the vicinity of Cheat Bridge it was most plentiful in open tracts of deciduous and coniferous woods. On several occasions while stalking birds, Perrygo heard the rustling of dead leaves near his feet, and for an instant the head or body of one of these shrews would appear.

**Greenbrier County:** Jobs Knob, 13 miles north-northwest of Renicks Valley, altitude 4,338 feet, 2.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 7.

**Randolph County:** Cheat Bridge, altitude 3,900 feet, 6.

**SOREX DISPAR** Batchelder

**GRAY LONG-TAILED SHREW**

A male of this species was taken by A. H. Howell in July 1909 in the southern part of the State on the cool north slope of a canyon forested with hemlock and deciduous trees. Further collecting may show that this shrew occurs in the eastern part of the State.

**Raleigh County:** Winding Gulf, 4 miles southwest of Pemberton, altitude 2,000 feet, 1.

**SOREX FUMEUS FUMEUS** Miller

**SMOKY SHREW**

Smoky shrews are most plentiful in the colder parts of the Transition and Canadian Zones in West Virginia. In the eastern part of the State they were found to be fairly common in the higher altitudes where the forest had not been burned over recently. These shrews were trapped by Perrygo and Lingeback only in wet boggy places and along the banks of streams. They were frequently taken in *Microtus* runways. Jackson (1928, p. 64) has commented on the shallow brain cases of some of the five specimens taken at Travellers Repose. He found, however, that other individuals from the same and nearby localities have high brain cases. The color shows no peculiarities.

Average measurements of seven males: Total length, 114 (110–120); tail, 46 (41–51); hind foot, 14.1 (13–15). Average measurements of nine females: Total length, 117 (110–132); tail, 46.5 (42–48); hind foot, 13.6 (12–15).

**Greenbrier County:** White Sulphur Springs, 1.

**Pendleton County:** Franklin, 1; Spruce Knob, altitude 4,860 feet, 1.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 9; Travellers Repose, 5.

**Raleigh County:** Winding Gulf, 4 miles southwest of Pemberton, 2.

**Randolph County:** Cheat Mountain, 3 miles west of Cheat Bridge, altitude 3,900 feet, 1.

It has been reported (F. E. Brooks, 1911, p. 28) also from French Creek, Upshur County; Terra Alta, Preston County; and Pickens and Osceola, Randolph County.

[**SOREX PALUSTRIS** subsp. ?]

**WATER SHREW**

Small mammals, locally known as water ground moles, were reported by Fred T. Galford, an employee of the E.C.W. at Camp Black Mountain, to occur along the head waters of Williams River at an altitude of 3,300 feet. They were described by Galford as diving into streams

like little muskrats and then hiding under the banks. When swimming submerged in the water they resembled little silver streaks. Galford reported that he had seen them most frequently on the head waters of Williams River, 5 miles east of Black Mountain.

**CRYPTOTIS PARVA (Say)**

**SMALL SHORT-TAILED SHREW**

This little short-tailed shrew seems to prefer dry fields overgrown with grass and weeds, though there are records of its occurrence in damp meadows and woods. A pair of these small shrews was collected in Greenbrier County by Thaddeus Surber during October 1897. Although thus far taken only in the southeastern corner of the State, it is quite likely that the animal will be found in some of the western counties drained by the Ohio River.

**Greenbrier County:** White Sulphur Springs, 2.

**BLARINA BREVICAUDA TALPOIDES (Gapper)**

**SHORT-TAILED SHREW**

Short-tailed shrews seem to be the most abundant insectivores in West Virginia. During April, in the western part of the State, they were readily trapped in underground runways. In some locations it frequently happened that it was necessary to kill off these shrews before undamaged specimens of other small mammals could be trapped. In the mountainous section of eastern West Virginia they were rather plentiful during 1936 and were trapped in wet bogs, along streams, near rotten logs and stumps, in meadows, and even in slide rock on steep hill slopes. Curiously enough Blarinas were caught at Odd in large Schuyler traps that had been nailed to the trunks of oak trees about 5 to 6 feet above the ground. These traps were set for flying squirrels and were baited with bird bodies. In the Cranberry Glades, Blarinas were caught likewise in traps nailed to the trunks of beech trees.

Pending a new revision of the genus, not much can be done in the way of distinguishing geographic races of *Blarina* in the Eastern United States. Those taken in eastern West Virginia average larger than the western series. From the eastern and southern parts of the State, the average measurements of 25 males are as follows: Total length, 121 (110-133); tail, 26.1 (22-33); hind foot, 14.9 (13.5-16). For 57 females from the same area the average measurements are: Total length, 115.6 (101-130); tail, 24.2 (16-34); hind foot, 14.9 (13-16). For a series of six males from the western part of the State the average measurements are: Total length, 111.3 (103-119); tail, 22 (18-24); hind foot, 14.1 (13.5-15). The average measurements of 10 females from the same area are as follows: Total length, 109.3 (94-118); tail, 22.8 (20-27); hind foot, 13.6 (13-14).



**Cabell County:** 5 miles east of Huntington, 8.

**Greenbrier County:** White Sulphur Springs, 9; 2 miles east of White Sulphur Springs, 2.

**Lincoln County:** Fourteen (27 miles southeast of Huntington), 2.

**Mason County:** Mercers Bottom, 7.

**Mercer County:** Flat Top, altitude 3,500 feet, 3.

**Pendleton County:** Franklin, 1; Spruce Knob, altitude 4,860 feet, 1.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 25; Williams River, altitude 3,300 feet, 9; Travellers Repose, 6.

**Raleigh County:** Ghent, altitude 2,900 feet, 4; Odd, altitude 2,900 feet, 8; Winding Gulf, 4 miles southwest of Pemberton, altitude 2,200 feet, 4.

**Randolph County:** Middle Mountain, 11 miles northeast of Durbin, 8; Cheat Mountain, 3 miles west of Cheat Bridge, altitude 3,900 feet, 9.

### Family VESPERTILIONIDAE

#### MYOTIS LUCIFUGUS LUCIFUGUS (LeConte)

##### LITTLE BROWN BAT

Bats, presumably this species, were occasionally observed at Summersville, Nicholas County. On Middle Mountain, Randolph County, bats were fairly common, but none were collected. W. M. Perrygo was told that hundreds of bats wintered in the caves in "The Sinks" on Gandy Creek, 4½ miles west of Spruce Knob, Randolph County. It is likely that several species of bats hibernate in these caves. Fred E. Brooks (1911, p. 29) reported that this bat was abundant at French Creek, Upshur County, and at Morgantown, Monongalia County. A. M. Reese (1934, pp. 45, 50, 51) records the little brown bat from Cornwall's Cave in Preston County, as well as from Arbuckle's, Rapp's, and Bunger's Caves in Greenbrier County.

**Greenbrier County:** White Sulphur Springs, 4.

**Pendleton County:** Franklin, 2.

#### MYOTIS SUBULATUS LEIBII (Audubon and Bachman)

##### LEIB BAT

There are no specimens of this bat from West Virginia in the National Museum collection. Miller and Allen (1928, p. 172), however, recorded one from White Sulphur Springs in Greenbrier County. Brooks writes that "many of these bats hibernate in the caves, hanging in dense masses from their roofs."

#### MYOTIS KEENII SEPTENTRIONALIS (Trouessart)

##### TROUESSART BAT

This bat has been recorded in the central and northern parts of the State, one having been taken in Braxton County (Miller and Allen, 1928, p. 107) and two in Preston County during August 1888.

**Preston County:** Aurora, 2.

*MYOTIS SODALIS* Miller and Allen

## INDIANA BAT

One individual weighing 7 grams was taken by A. B. Brooks on March 16, 1928.

Monongalia County: Cave near Morgantown, 1.

Preston County: Cheat River, 1.

*LASIONYCTERIS NOCTIVAGANS* (Le Conte)

## SILVER-HAIRED BAT

Surber (1909, p. 55) lists this bat from West Virginia but cites no definite records. He remarks that it is more partial to the forests than the other species.

*PIPISTRELLUS SUBFLAVUS SUBFLAVUS* (F. Cuvier)

## GEORGIAN BAT

Further collecting in the caves of West Virginia will probably show that this small bat occurs throughout the State. A male taken by Vernon Bailey on November 1, 1924, at Charleston weighed 3.7 grams. A. M. Reese (1934, pp. 45, 47, 50, 51, 53) reports that he has collected Georgian bats in Cornwall's Cave in Preston County; The Sinks Cave no. 1 in Randolph County; Smoke Hole Cave in Pendleton County; Rapp's, Bunger's, and Saltpeter Cave no. 1 in Greenbrier County; and in Green Saltpeter, Argobrite's, and Union Caves in Monroe County.

Kanawha County: Charleston, 1.

Pendleton County: Franklin, 6.

*NYCTERIS CINEREA* (Beauvois)

## HOARY BAT

A. B. Brooks (1929, p. 541) writes that this bat "is reported as occurring in West Virginia", but he cites no definite records. Surber (1909, p. 55) likewise lists it as a rare migrant.

*NYCTERIS BOREALIS BOREALIS* (Müller)

## RED BAT

Although the available records for the red bat are all from the eastern and southern counties, this animal should occur throughout the State. During the summer months at least this bat is not gregarious, and during the daylight hours it is often found suspended from a lower branch of some small tree or shrub.

Pendleton County: Franklin, 1.

Raleigh County: Near head of Sand Lick Creek, 1.

Wyoming County: Near Baileysville, 1.

*EPTESICUS FUSCUS FUSCUS* (Beauvois)

## BIG BROWN BAT

Four specimens were collected by Thaddeus Surber and Wirt Robinson during April and May 1897 in the southeastern corner of the State. A male taken in Preston County during March 1928 by A. B. Brooks weighed 12 grams. This bat frequently gets into houses and outbuildings during the fall and winter months. It also hibernates in hollow trees and crevices in rocks, as well as in caves. The brown bat has been taken by A. M. Reese (1934, pp. 45, 47) in Cornwall's Cave in Preston County and in Smoke Hole Cave in Pendleton County.

**Greenbrier County:** White Sulphur Springs, 4.

**Preston County:** Cheat River, 1; Cronwell Cave (recorded by A. B. Brooks, 1929, p. 541).

*CORYNORHINUS RAFINESQUI RAFINESQUI* (Lesson)

## BIG-EARED BAT

Though actual records are restricted to Pendleton, Randolph, and Preston Counties, this bat should occur in caves throughout the State. The big-eared bat, as the name implies, is readily recognized by its unusually long ears, equaling about one-third of the total length of the animal. The ears are connected at the base across the forehead. On June 13, 1933, A. M. Reese collected four females, each nursing one young, in Pendleton County. Most of the individuals listed below were found hanging head downward either in a cave or in dark crevices in rocks. This bat, according to A. M. Reese (1934, p. 47) has been taken also in The Sinks Cave no. 1 in Randolph County and in Seneca Caverns in Pendleton County.

**Pendleton County:** Brushy Run, 1; Cave Mountain Cave, 1; Upper Tract, 8.

## Family URSIDAE

*EUARCTOS AMERICANUS AMERICANUS* (Pallas)

## BLACK BEAR

Black bears appear to have ranged over the whole State at the time of settlement. Bear meat formed a substantial part of the staple diet of hunters and settlers. Of the many records, a few have been selected to indicate the extent of the former range of the species. On May 9, 1751, Christopher Gist (Darlington, 1893, pp. 65, 135) killed a bear on Indian Creek in Monroe County. Gist also killed bears during January 1752 at the head of Fish Creek in Marshall County (Darlington, 1893, pp. 72, 142) and on March 5, 1752, on Fishing Creek in Wetzel County (pp. 76, 145). In May 1765 Colonel Croghan (1831, p. 260) reported that bears were abundant along the Ohio River between the mouth of the Little Kanawha River and the Big Bend. According to McWhorter (1915, p. 80) the early settlers killed many bears along Hackers Creek in Harrison County.

While collecting along the Guyandotte River in Logan County, we received reports that black bears are occasionally killed in the surrounding mountains. Reports indicate that bears are still fairly abundant in the eastern counties, especially in timbered lands overgrown with thickets. During 1936 they were rather common around Cranberry Glades, in the mountains along Williams River, in the vicinity of Cheat Mountain. Numerous tracks were seen on Middle Mountain during July 1936. On July 4, 1936, a black bear killed six sheep belonging to a resident of Middle Mountain. Another resident of Middle Mountain is reported to have killed 14 bears during the winter of 1934-35. On September 21, 1936, while collecting on Spruce Knob, W. M. Perrygo was told that a bear had killed several sheep during the preceding night.

Periodical "game drives" on the Monongahela National Forest supervised by forest rangers have furnished some interesting data on the relative abundance of some of the larger mammals. According to Arthur A. Wood, forest supervisor, the method of obtaining these tallies is as follows: 12 sample plots of 160 acres each have been established at various points within the Monongahela Forest boundaries, and each area is systematically "driven" by 120 men, four times each year. Of these 120 men, at least half form the "drivers' " line and the rest are stationed at equal distances around the drive boundaries of the area to count the game. At a prearranged signal the drivers' lines advance from one end of the area to the other, driving through the stationary lines all the larger mammals found on the area. On the basis of the data thus obtained the mean abundance of the species is calculated. By this method it has been found that black bears are most abundant in the drive areas located in the northern hardwood timber on the Little River drainage in northern Pocahontas County. The forest records show a yearly mean population of 1 bear to each 993 acres in this section. For the entire forest, the calculation is 1 bear to each 2,518 acres.

**Randolph County:** Cheat Mountain, 1.

Family PROCYONIDAE  
PROCYON LOTOR LOTOR (Linnaeus)  
RACCOON

No specimens of this fairly common fur bearer have been received from West Virginia by the National Museum. I have examined, however, the skin of a raccoon killed during 1936 near Williams River, 5 miles east of Black Mountain, Pocahontas County. Raccoon tracks were found along the Guyandotte River near Barboursville in Cabell County and along the Ohio River near Point Pleasant in Mason County during April 1936. Trappers working along the Cranberry River near the glades say that the raccoons live in dens in the rocks and rarely are found in hollow trees.

## Family MUSTELIDAE

## MARTES PENNANTI PENNANTI (Erleben)

## EASTERN FISHER, OR PEKAN

Although the range of the fisher formerly extended southward in the Allegheny Mountains to North Carolina, there are very few authenticated records for West Virginia. Fred E. Brooks (1911, p. 26) writes that E. C. Barrett, of Beckley [Raleigh County] bought three fisher skins from Moses Stover, in 1871, 1872, and 1873, paying for them \$3, \$3.50, and \$5, respectively. The animals were trapped on the Clear Fork of Big Coal River. Brooks believed that the records of the carnivore called "black fox" by the early settlers should be accredited to the fisher. Christopher Gist (Darlington, 1893, pp. 76, 145) states that he killed a "black fox" on March 5, 1752, on Neemokeesy Creek [=Fishing Creek] in Wetzel County. These animals were occasionally caught by Edwin Phillips (A. B. Brooks, 1929, p. 538), a pioneer in Upshur County, in log bear traps. Surber (1909, p. 55) says that the fisher "formerly occurred in some numbers in the black spruce region."

## MUSTELA RIXOSA ALLEGHENIENSIS (Rhoads)

## LEAST WEASEL

This weasel is the smallest of all the North American carnivores and is rarely taken by trappers.

Pocahontas County: Travellers Repose, 1.

Randolph County: Huttonsville, 1.

Ohio County: Oglebay Park, recorded by A. B. Brooks (1929, p. 541).

## MUSTELA FRENATA NOVEBORACENSIS (Emmons)

## NEW YORK WEASEL

Specimens of the New York weasel have been collected in the northern and eastern parts of West Virginia. The animal should occur throughout the State. This weasel often lives in stone fences, in the vicinity of cabins, and in farm buildings. Near Philippi it was reported as being most plentiful in the vicinity of rock ledges on the hillsides. One was caught in a trap set in a rock crevice for wood rats. Another was taken on Spruce Knob and still another at Cranberry Glades in large Schuyler traps that had been nailed to the trunks of spruce trees. These traps were set about 5 to 6 feet above the ground and baited with bacon.

Barbour County: 7 miles east of Philippi, 1.

Hardy County: 1.

Pendleton County: Spruce Knob, altitude 4,860 feet, 1.

Pocahontas County: Cranberry Glades, altitude 3,300 feet, 1.

**MUSTELA VISON VISON** Schreber**MOUNTAIN, OR BLACK, MINK**

Surber (1909, p. 55) says that this mink occurs only in the black-spruce belt. Black minks have been trapped by Frank Houchin in the spruce belt in the vicinity of Cranberry Glades (Brooks, 1911, p. 25). Trappers along the Williams River reported that pelts of this mink brought a much higher price than those of the lowland mink. Minks were reported to be plentiful along Williams River, Cranberry River, Cheat River, and Shavers River in the eastern part of the State during 1936, but no specimens were procured by the Museum party.

**MUSTELA VISON MINK** Peale and Beauvois**COMMON, OR BROWN, MINK**

This mink occurs in hilly regions and lowlands in all parts of the State. Trappers reported that they were fairly plentiful on Peters Creek in Nicholas County in the summer of 1936. No specimens of this common fur bearer have been received from West Virginia by the National Museum.

**LUTRA CANADENSIS CANADENSIS** (Schreber)**OTTER**

A. B. Brooks (1929, p. 541) says that the otter "is still found along certain streams in the less populous counties." Arthur A. Wood, forest supervisor, thinks, however, that there is no evidence that otters now occur in the Monongahela National Forest. Nevertheless, otters were trapped along most of the major streams of the State before the Civil War. An otter (U. S. N. M. no.  $\frac{2255}{3118}$ ), collected by A. Brakeley at Rowlesburg in Preston County, was received in the flesh at the Smithsonian Institution during January 1857. This specimen probably was mounted by C. Drexler for the exhibition series. No record of its subsequent disposition has been found.

**SPILOGALE PUTORIUS** (Linnaeus)**SPOTTED SKUNK**

A. B. Brooks (1929, p. 541) writes that the spotted skunk occurs "at low elevations in southern and eastern counties." Fred E. Brooks (1911, p. 25) reports that a few skins are received each year by a fur dealer in Huntington from the valley of Big Sandy River and that skins have been seen in stores at Franklin in Pendleton County. Trappers say that this skunk is found along the valley of the south branch of the Potomac River. Howell (1906, p. 17) records one from White Sulphur Springs in Greenbrier County. There are no specimens collected in West Virginia in the National Museum.

**MEPHITIS MEPHITIS ELONGATA** Bangs**FLORIDA SKUNK**

To this species Howell (1901, p. 28) has referred skunks taken in the eastern part of the State. He considers that they are fairly typical with the exception of slightly shorter tails. In October 1896 Fred E. Brooks (1911, p. 24) found one lying dead on a path through the dense spruce woods on the summit of Black Mountain. Brooks also says that skunks were abundant in the vicinity of Cranberry Glades during the winter of 1908-1909.

Pocahontas County: Green Bank, 1; Travellers Repose, 2.

**MEPHITIS MEPHITIS NIGRA** (Peale and Beauvois)**EASTERN SKUNK**

A female from Cabell County in the Ohio River drainage and a male from Raleigh County seem to agree more closely with the common eastern skunk. This species has been recorded (A. B. Brooks, 1929, p. 542) also at Oglebay Park, Ohio County. Skunks were fairly common in Nicholas County during 1936. On May 7, 1936, a skunk that had been run over by an automobile was found in the road near Middleton. Numerous skunks are reported to be trapped each year on the rock ledges in the vicinity of Philippi, Barbour County.

Cabell County: Barboursville, 1.

Raleigh County: Odd, altitude 2,900 feet, 1.

**Family CANIDAE****VULPES FULVA FULVA** (Desmarest)**RED FOX**

According to early hunters and settlers, red foxes first made their appearance in West Virginia more than a century ago and invaded the State from the north (Brooks, 1911, p. 23). Pioneer settlers have repeatedly stated that they found only gray foxes. The red fox, according to information obtained in 1936, is quite rare in many sections. On the other hand, A. B. Brooks (1929, p. 542) reported that the range of this species covers all of West Virginia. William Bolton told W. M. Perrygo that he had trapped red foxes near Philippi in Barbour County. Local trappers in the vicinity of Black Mountain say that red foxes are occasionally trapped in Pocahontas County. According to Arthur H. Wood, forest supervisor, red foxes are fairly well distributed over the entire Monongahela National Forest and are somewhat more numerous in the northern hardwood tracts. Calculations based on tally counts made during periodical drives on twelve 160-acre plots within the forest indicate a mean abundance of

1 red fox to each 1,886 acres. No specimens of this fox taken in West Virginia are in the National Museum collection.

**UROCYN CINEREOARGENTEUS CINEREOARGENTEUS (Schreber)**

**GRAY FOX**

In 1936 gray foxes seemed to be fairly common in Nicholas County, where low rolling hills and rock cliffs abound. I have examined the skin of one killed near Summersville during December 1935. At Philippi, in Barbour County, William Bolton told us that he had trapped a number of gray foxes in previous years. About 2 miles east of Fourteen, Lincoln County, Perrygo and Lingebach located a den during April 1936, but circumstances were such that they did not have opportunity to trap a specimen. Within the Monongahela National Forest, according to Arthur A. Wood, forest supervisor, gray foxes occur chiefly in the northern hardwood tracts of the forest. Tally counts made during the periodical drives in this forest indicate a mean abundance of 1 gray fox to each 1,511 acres.

After a conference with Secretary Joseph Henry during July 1848, Spencer F. Baird agreed to make a collection of natural-history specimens for the Smithsonian Institution. Most of this collection, including the skull of an old gray fox (no. 671) from Greenbrier County, was cataloged shortly after Baird's arrival in Washington. In January 1856 another specimen (no.  $\frac{1556}{2384}$ ), collected at Rowlesburg in Preston County, was received from A. Brakeley. This specimen cannot now be found.

**Greenbrier County:** White Sulphur Springs, 1.

**CANIS LUPUS LYCAON Schreber**

**GRAY WOLF**

Although no longer found in West Virginia, wolves were once fairly common in many parts of the State. Nevertheless, there are relatively few published records. In 1787, Levi Morgan narrowly escaped capture by the Indians while skinning a wolf that he had trapped on Buffalo Creek, Monongalia County (Withers, 1831, p. 278). Bounties were paid for wolves as early as 1788 and as late as the Civil War (Maxwell, 1898, p. 216). In 1801, a bounty of £1 (\$3.33) was paid for a full-grown wolf. This bounty was raised to \$35 in 1889 (Morton, 1910, p. 357). Wolves were said to have been fairly numerous as late as 1815 along Finks Creek, but the last wolf was killed in Gilmer County before 1852 (McWhorter, 1915, pp. 149, 329-330). A wolf was seen in 1854 on Buckhannon Run, Hackers Creek, Harrison County (Lewis, 1912, p. 135). Maxwell (1898, p. 216) records the number of wolves killed in Randolph County from 1787 to 1861. The number killed fluctuated from year to year—44



in 1810, 51 in 1816, 56 in 1822, and 51 in 1824, but only 2 in 1861. Maxwell (1898, pp. 215, 216), says that a wolf was killed near St. George, Tucker County, as late as 1894 and one in Randolph County in 1897. Regarding Pendleton County, Morton (1910, pp. 357-358) writes that A. W. Roby killed two wolves in 1889, Thomas A. Payne two wolves in 1892, and S. P. Dolly and Jacob Arbogast two wolves in 1896. According to Brooks (1911, p. 24) the last record for the State is a wolf killed by Stofer Hamrick during January 1900 in Randolph County.

### Family FELIDAE

#### FELIS CONCOLOR COUGUAR Kerr

#### COUGAR, PANTHER, OR EASTERN MOUNTAIN LION

When the first settlers arrived, panthers were reported to have been commoner in the Allegheny Mountains than elsewhere in the State. Nevertheless, they were at one time numerous enough in most sections to disturb the settlers. McWhorter (1915, pp. 346, 488) has published records of panthers in Taylor County and along Blood Run and Horn Creek, tributaries of the Little Kanawha River. Panthers were reported to have been fairly common up to and even later than 1815 along Finks Creek in Gilmer County (McWhorter, 1915, p. 326). A panther killed by John Riffle in 1855 on Oil Creek appears to be the last record for Lewis County (McWhorter, 1915, p. 353). McWhorter (1915, p. 347) likewise records panthers on White Oak Run, Middle Fork River, and on Cheat Mountain in Randolph County. In 1850, C. B. R. Kennerly presented to the Smithsonian Institution the skeleton of one (no. 848) killed at Capon Springs in Hampshire County.

According to the statistical tabulations published by Maxwell (1898, p. 216), 11 panthers were killed in Randolph County in 1853, 14 in 1856, 11 in 1858, and 6 in 1859. Fred T. Galford, a skilled worker employed by the E.C.W. at Camp Black Mountain, Monongahela National Forest, reports finding tracks of a panther in the snow on Black Mountain during the winter of 1935 and also in 1936. He and members of a C.C.C. camp saw one at the same locality walking along a footpath during the summer of 1936. Forest employees were convinced that one or more go over Black Mountain in Pocahontas County about twice every 10 days. W. M. Perrygo and C. Lingebach saw panther tracks on Kennison Mountain, Pocahontas County, during the latter part of June 1936. They also noticed tracks on Middle Mountain in Randolph County. Arthur A. Wood, forest supervisor, Monongahela National Forest, writes that there is some evidence of a very few panthers in the Middle Mountain section of Randolph and Pocahontas Counties.

## LYNX RUFUS RUFUS (Schreber)

## BOBCAT, OR WILD CAT

Maxwell's tabulation (1898, p. 216) of bounty payments shows that bobcats were abundant in Randolph County before the Civil War, 66 being killed in 1855, 106 in 1857, and 80 in 1859. An adult and a young collected at Rowlesburg were shipped to the Smithsonian Institution in January 1856 by A. Brakeley. In the interval between March 1897 and February 1902, W. J. Yeager collected 25 bobcats in Pocahontas County for the U. S. Biological Survey. The West Virginia Conservation Commission reported that bounty payments had been made on 153 bobcats during the year 1936. Of these, 30 were killed in Pocahontas County and 21 in Randolph County. The bobcat seems to have adapted itself to changing conditions and now survives in the partially cleared land and also in the forested areas of eastern West Virginia.

There is some seasonal as well as considerable individual variation in the coloration and the extent of spotting, but apparently no sexual correlation. No seasonal uniformity in the degree of intensity of the color tones in the spots was observable in a series of 29 skins. The spots were, however, much more sharply demarcated on the limbs and the sides of the body than elsewhere.

The two males taken during October and November are more rufous and much lighter in coloration than the other specimens, and the long black overhairs do not materially darken the upperparts. In the case of eight males and six females taken during January, the tawny mid-dorsal stripe is accentuated by the long black overhairs. The spotting on the sides of the body is rather conspicuous on two of the males. Of the four males taken during February, two are somewhat grayish and the others more cinnamon colored. The wearing off of the long black overhairs and the light tips of the other hairs on skins of animals taken during March, April, and May likewise alters the color tones.

The coloration of the underparts seems to be more uniform than that of the upperparts. During the winter months the males seem to have more white hair. In the case of the females, however, the long white hairs are largely restricted to the throat and chest, while the cinnamon-buff to pinkish-cinnamon hairs of the sides encroach on the median line of the belly.

Average measurements of 11 adult males: Total length, 870 (787-935); tail, 146 (133-165); hind foot, 171 (162-195). Skull: Greatest length, 126 (120-131); condylobasal length, 114.3 (109.4-118.6); depth of braincase at basisphenoid, 43.8 (42.8-45.5); zygomatic breadth, 88.3 (82.2-93); mastoid breadth, 54.2 (50.3-58.6); interorbital constriction, 23.3 (22.5-26.6); distance between ends of postorbital processes, 59 (55.5-66); least distance anteriorly between

outer walls of hamular processes of pterygoids, 15 (14-17); alveolar length of upper canine-premolar-molar series, 38.2 (36.8-39.9); crown length of upper carnassial, 14.6 (13.9-15.4).

Average measurements of 8 adult females: Total length, 772 (737-813); tail, 144 (136.5-156); hind foot, 158 (152-165). Skull: Greatest length, 113.1 (110-116.5); condylobasal length, 103.7 (101.2-106.7); depth of braincase at basisphenoid, 42.5 (40.1-44.5); zygomatic breadth, 78.7 (75.2-81.8); mastoid breadth, 48.2 (46.5-49.8); interorbital constriction, 20.6 (19-22); distance between ends of postorbital processes, 54.6 (50.6-58.8); least distance anteriorly between outer walls of hamular processes of pterygoids, 14 (13-14.8); alveolar length of upper canine-premolar-molar series, 34.8 (33.7-35.6); crown length of upper carnassial, 13.7 (13-14.3).

**Greenbrier County:** White Sulphur Springs, 2; Renicks Valley, 1.

**Hardy County:** Capon Iron Works, 1.

**Pocahontas County:** Green Bank, 9; Travellers Repose, 16.

**Preston County:** Rowlesburg, 1.

## Family SCIURIDAE

### *MARMOTA MONAX MONAX* (Linnaeus)

#### SOUTHERN WOODCHUCK, OR GROUNDHOG

The woodchuck is fairly common throughout the State except in the coniferous forests. The burrows of this rodent are found especially along the sparsely forested banks of streams bordering on cultivated fields, in clearings in deciduous woods, and also under large rocks on hillsides. On April 22, 1936, we were surprised to find freshly opened burrows in the bottomlands along the Guyandotte River from which the flood waters had receded only a short time previously. On two occasions that week we came upon woodchucks that were sunning themselves near their burrows, although the weather at the time was decidedly cold and raw.

**Cabell County:** 4 miles east of Huntington, 2.

**Greenbrier County:** Jobs Knob, 13 miles north-northwest of Renicks Valley, 1.

**Hampshire County:** Springfield, 1.

**Hardy County:** North Mountain, 1.

**Nicholas County:** Drennen, 2.

**Pendleton County:** Franklin, 3; Spruce Knob, altitude 4,860 feet, 2.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 2; Williams River, 1.

**Preston County:** Rowlesburg, 1.

**Randolph County:** Middle Mountain, 11 miles northeast of Durbin, 3.

### *TAMIAS STRIATUS FISHERI* Howell

#### FISHER CHIPMUNK

The chipmunk seems to be distributed over the whole State. Its burrows are commonly found under or near stumps of dead trees and piles of tangled driftwood along the banks of streams. On rocky

hillsides the animals appear to prefer crevices in exposed rocky ledges. In coniferous forests on the mountain slopes they are most plentiful around rotten trunks of fallen trees. During 1936 the first specimen was taken in Cabell County on April 23 and the last on October 17 on Great Flat Top Mountain in Raleigh County.

**Barbour County:** 7 miles east of Philippi, 2.

**Cabell County:** 5 miles east of Huntington, 2.

**Calhoun County:** 5 miles west of Grantsville, 2; Freed, 1.

**Greenbrier County:** White Sulphur Springs, 3.

**Logan County:** 1½ miles south of Big Creek, 1.

**Mercer County:** Flat Top, altitude 3,200 feet, 1.

**Morgan County:** Berkeley Springs, 2.

**Nicholas County:** Gilboa, 3; Pine Creek, 1½ miles north of Zela, 1.

**Pendleton County:** Franklin, 9; Spruce Knob, altitude 4,700 feet, 2.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 4.

**Baleigh County:** Odd, altitude 2,900 feet, 1; Redbird, 2.

**Randolph County:** Elkins, 1; Middle Mountain, 12 miles northeast of Durbin, 3.

#### TAMIASCIURUS HUDSONICUS ABIETICOLA Howell

#### CLOUDLAND RED SQUIRREL, OR PINE SQUIRREL

During 1936 the National Museum party did not obtain any authentic records of the occurrence of the Cloudland red squirrel outside of the Allegheny Mountain region. Red squirrels were found mostly in the spruce woods. Occasionally they were observed in mixed woods of deciduous and coniferous trees. In 1936 red squirrels seemed to be more abundant on Cheat Mountain and along both forks of the Cranberry than elsewhere in the areas visited by the Museum party. In Pocahontas County the red squirrel is called "fairy-diddle." In 1896 Fred E. Brooks (1911, p. 14) found red squirrels feeding on buckeyes on the slopes of Black Mountain. The "vermin" campaigns now being conducted in West Virginia are depleting the numbers of these squirrels. Unfortunately, in campaigns of this sort, where a premium is placed on the number of red squirrels taken, no concerted effort is made to restrict the killing to areas where control may appear advisable.

The seasonal changes of pelage are marked, the most noticeable characteristics of the winter pelage being the longer hairs, the less noticeable grizzling of the upperparts, and the presence of a broad dorsal reddish band extending from top of head to base of tail. In summer the pelage is darker and distinctly grizzled, and the reddish dorsal band is absent.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 12; Williams River, 12 miles west of Marlinton, altitude 3,300 feet, 2; Travellers Repose, 13.

**Randolph County:** Cheat Mountain, 3 miles west of Cheat Bridge, altitude 3,900 feet, 5; Middle Mountain, 11 miles northeast of Durbin, 5.

## TAMIASCIURUS HUDSONICUS LOQUAX (Bangs)

## EASTERN RED SQUIRREL, CHICKAREE, OR PINEY

The southern limit of the range of the eastern red squirrel is found along the border of northern West Virginia. A summer specimen from Berkeley Springs in the Potomac River drainage is referred to this race. A. B. Brooks (1929, p. 542) writes that red squirrels taken at Oglebay Park, Ohio County, in the Ohio River drainage have been identified as *T. h. loquax*.

Morgan County: Berkeley Springs, 1.

## SCIURUS CAROLINENSIS LEUCOTIS Gapper

## NORTHERN GRAY SQUIRREL

Gray squirrels seemingly prefer the lower levels of the mountainous portions of West Virginia. They are found in both deciduous and mixed woods. In the eastern part of the State, during the summer months especially, they occur on the lower mountain slopes. When hickorynuts and other mast are plentiful in fall, they do not come down to the lowlands in search of food. When food is scarce, however, they migrate to the lowlands where they feed on buckeyes and whatever else is available. In the western part of the State they are found most commonly in the deciduous woods on the ridges that border the stream valleys.

All the West Virginia specimens are referred to the northern race of gray squirrel. Winter specimens from the eastern part of the State have the light-gray coloration of *leucotis*, including the light clay-colored dorsal band and the predominance of whitish- or whitish-gray-tipped hairs in the tail, as well as large hind feet and long tail. Summer specimens likewise have a coloration similar to the northern race. The average measurements of nine females are: Total length, 473 (430-496); tail, 212 (196-226); hind foot, 67.6 (65-69). For eight males the average measurements are: Total length, 471.7 (459-490); tail, 210.7 (195-220); hind foot, 66.7 (63-71).

Specimens from the western part of the State are not typical, but in coloration they are nearest to the northern race. Winter specimens from Cabell County have the upperparts light grayish as in *leucotis*, but they approximate true *carolinensis* from the Carolinas by having smaller hind feet and shorter tail. Summer specimens from Barbour County likewise agree more closely in coloration with the northern race but approach the southern race more closely in the lengths of the hind feet and tail.

Melanism is common at some localities. The melanistic phase appears to have been particularly prevalent in 1895 at Frankford. Six melanistic specimens are grizzled on the side, the clay-colored subapical band persisting on the long black hairs.

By an act of the Virginia Assembly in 1769, each head of family was required to produce "per tithe the heads of five squirrels or crowns" (Morton, 1910, p. 357).

**Barbour County:** Sugar Creek, 5 miles east of Philippi, 1; Bills Creek, 7 miles east of Philippi, 1.

**Cabell County:** 4 miles east of Huntington, 2; 13 miles east of Huntington, 1.

**Greenbrier County:** Frankford, 4; Ronceverte, 1; White Sulphur Springs, 1.

**Pendleton County:** Franklin, 1.

**Pocahontas County:** Travellers Repose, 3; Williams River, 12 miles west of Marlinton, altitude 3,200 feet, 8.

**SCIURUS NIGER NEGLECTUS (Gray)**

**NORTHERN FOX SQUIRREL**

This large, long-tailed squirrel seems to be less adaptable than the gray squirrel to the changing conditions brought on by the settlement of the wooded areas of the East. In West Virginia it now survives in the heavily wooded and sparsely settled higher altitudes of the Allegheny Mountains. On Spruce Knob, in Pendleton County, the fox squirrel is called the highland squirrel. A fox squirrel was seen by W. M. Perrygo at an elevation of 4,600 feet on Albemarle Ridge, east of Travellers Repose. On this area it is reported that these squirrels feed largely on chestnuts during the fall and winter months.

For many years numbers of fox squirrels were shipped to Center Market in Washington, D. C., from points in western Virginia and from eastern West Virginia. There are two specimens in the National Museum collection labeled merely West Virginia that were purchased at this market, one (no. 16315) bought by William Palmer on October 10, 1888, and the other (no. 22752) by Morris M. Green on December 12, 1888. Another specimen (no. 107620), purchased at the same market during January 1895, is labeled Hightown, Va., a locality in Highland County close to the West Virginia boundary.

In 1896 Thaddeus Surber collected for Outram Bangs three adult fox squirrels at White Sulphur Springs in Greenbrier County. One of them became the type of a new race, *Sciurus ludovicianus vicinus* Bangs. Gray's name (applied to a Delaware specimen) is older and therefore has precedence.

A series of 15 fox squirrels collected by Thaddeus Surber during October 1897 at Lewisburg illustrates the color variation in the pelage. The upperparts of some of these specimens are rather light in color. A specimen (no. 114012) taken in Hampshire County, however, has lighter gray upperparts than any of the Lewisburg specimens, the subapical band on the black-tipped hairs being faded to a light clay color and the other hairs broadly tipped with light gray. The feet of this specimen are whitish. The feet of the Lewisburg specimens vary from light ferruginous to a pale yellowish gray or dingy white. On one squirrel (no. 91499) the thighs, hindfeet,

forearm, forefeet, entire head, chin, throat, and underparts are black, but the remainder of the pelage is normal. Nine of these specimens have more black hairs on the head than the others. The throat and chest are washed with pinkish buff on all but two of this series. Two have whitish underparts. Three have the entire underparts suffused with pinkish buff. On all the others this pinkish-buff suffusion extends backward along the median line. The under surface of the tail is normally ferruginous.

Fred E. Brooks (1911, p. 14) reports that he has seen this squirrel at French Creek, Upshur County, and in beech woods near Edray, Pocahontas County. Specimens taken at Oglebay Park, Ohio County, according to A. B. Brooks (1929, p. 543), have been identified as *Sciurus niger rufiventer*.

**Greenbrier County:** Lewisburg, 15; White Sulphur Springs, 9.

**Hampshire County:** 1.

**Pocahontas County:** Academy, 1.

#### GLAUCOMYS VOLANS VOLANS (Linnaeus)

##### SMALL EASTERN FLYING SQUIRREL

These small flying squirrels seem to be fairly common in all the wooded parts of the State. Because of their crepuscular and nocturnal habits, they are rarely seen. In Mason County these squirrels were found in the deciduous woods on the bluffs along the Ohio River. They seem to be fairly numerous in the open oak woods on the flat-topped hills of Barbour County. On warm nights, during the first week of June 1936, Perrygo and Lingebach repeatedly heard thuds and the familiar scratching of claws on the bark of trees around their camp 6 miles south of Philippi. In the lowlands along Nicholas Creek near Gilboa on May 6, 1936, one was found curled up at the bottom of an abandoned woodpecker hole in a dead tree. One was trapped on November 1, 1936, on the trunk of a white oak in a mixed deciduous and coniferous forest near the top of Katis Mountain south of White Sulphur Springs. On September 2, 1895, Thaddeus Surber collected a male at an altitude of 3,200 feet on Katis Mountain; this specimen subsequently became the type of *Sciuropterus silus* Bangs. Howell (1918, p. 22) has concluded that *silus* is "an immature individual of *volans*, evidently a runt." Other specimens from the same mountain, including one examined by Bangs, are clearly referable to *volans*. At an altitude of 3,700 feet, on the top of Cranberry Mountain, they seemed to prefer the big white oaks. Along Williams River they were found in a thick forest of sugar maple, oak, and beech. On the colder nights of late spring and early fall very little activity was noted. Nevertheless, flying squirrels leave their nests from time to time during winter months, for C. G. Rorebeck collected two males at Travellers Repose during the last week of February 1897.

**Barbour County:** Bills Creek, 7 miles east of Philippi, 7; Sugar Creek, 5 miles east of Philippi, 3.

**Greenbrier County:** Katis Mountain, White Sulphur Springs, altitude 3,000 feet, 2.

**Mason County:** Mercers Bottom, 1.

**Nicholas County:** Gilboa, 1.

**Pocahontas County:** Cranberry Mountain, Cranberry Glades, 1; Travellers Repose, 2; Williams River, 12 miles east of Marlinton, 1.

**Raleigh County:** Odd, altitude 2,900 feet, 1.

**GLAUCOMYS SABRINUS FUSCUS** Miller

**WEST VIRGINIA FLYING SQUIRREL**

The range of this gray-faced flying squirrel within the State is imperfectly known. The type specimen was taken at an altitude of 3,300 feet in a fairly thick forest of spruce, sugar maple, beech, and yellow birch. It was caught in a Schuyler trap nailed to the trunk of a large spruce growing about 10 yards from the bank of the north fork of the Cranberry River. Two individuals were trapped at an altitude of 3,900 feet on Cheat Mountain in a tract of sugar maple, beech, yellow birch, and spruce. Both of these specimens were taken in traps nailed to the trunks of very large shaggy-barked sugar maples. On the basis of these occurrences it appears that this flying squirrel lives in the Canadian life zone in eastern West Virginia. Doutt (1930, p. 239) collected a northern flying squirrel in an isolated tract of similar Canadian trees in Potter County, Pa. This indicates that the animal may also occur in the Allegheny Mountains in the north-eastern part of the State.

**Randolph County:** Cheat Mountain, 3 miles west of Cheat Bridge, 2.

**Pocahontas County:** Cranberry Glades, 1.

**Family CASTORIDAE**

**CASTOR CANADENSIS CANADENSIS** Kuhl

**NORTHERN BEAVER**

There are surprisingly few references to beavers in West Virginia in the accounts left by early travelers. English and French traders had established posts along the Ohio River prior to the arrival of the settlers. Before 1740 the Pennsylvania trader James Le Tort had a post at Letart, Mason County. Beaver skins were valued at 6 shillings a pound in 1763 (Hanna, 1911, p. 374). According to Hale (1886, p. 170), Paddy Huddlestone and Daniel Boone trapped about a dozen beavers at the upper end of Long Shoal, a few miles below Kanawha Falls, Fayette County. Boone was a surveyor in this region from 1789 to 1798. The beaver reported killed in Pocahontas County about 1907 is thought to have escaped from captivity (Brooks, 1911, p. 15). Some years ago remnants of old beaver dams were



found on the Williams and Greenbrier Rivers. According to Brooks (1929, pp. 536-537) freshly cut trees and a dam were found in 1925 in Hampshire County on Tarcoat Creek, an indirect tributary of the Great Cacapon River. It was thought that these beavers had entered the State by way of the Potomac and Great Cacapon Rivers. Shortly afterward this colony moved to North River where suitable food was more plentiful. This colony disappeared within three years.

### Family CRICETIDAE

#### REITHRODONTOMYS HUMULIS IMPIGER Bangs

##### SHORT-EARED HARVEST MOUSE

Thaddeus Surber found that this harvest mouse was comparatively common in fields overgrown with weeds near White Sulphur Springs. Five specimens were sent to Outram Bangs and one of them became the type of this race. Others were subsequently acquired by the Biological Survey from the same collector. The Museum party did not collect any specimens at this locality. Howell (1914, p. 21) has concluded that this is "a rather poorly marked race of *humulis* occupying the northern end of the range of the species."

Greenbrier County: White Sulphur Springs, 9.

#### REITHRODONTOMYS HUMULIS MERRIAM Allen

##### MERRIAM HARVEST MOUSE

One specimen was trapped at Ceredo by A. H. Howell on July 29, 1910, in a low uncultivated field overgrown with grass and weeds and situated between the railroad tracks and the Ohio River. At the time of our visit in April 1936, all these lowlands including this field had been flooded recently by the Ohio River. Our trapping there indicated that all the smaller mammals had either been destroyed or driven away by this flood. Elsewhere it has been reported that this mouse generally selects a matted tangle of grass, weeds, or briars, often in wet bottomland or at edge of a marsh. Hence it is quite likely that the floods periodically reduce its numbers.

Wayne County: Ceredo, 1.

#### PEROMYSCUS LEUCOPUS NOVEBORACENSIS (Fischer)

##### NORTHERN WHITE-FOOTED MOUSE, OR DEER MOUSE

This nocturnal mouse is rarely found at any great distance from timber or brush of some sort. Available records indicate that its vertical range stops at about 3,000 feet. It ranges over most of the western half of the State and is found also in the southeastern and northeastern counties.

On the wooded bluffs along the Ohio River the northern white-footed mice were most abundant near rock ledges. In the Guyandotte River Valley they were usually trapped under the exposed roots of elms and oaks growing on the banks of small streams. Along Sugar Creek near Philippi they were caught in traps set in crevices in the rock ledges on hillsides forested with birch, oak, and poplar. They were caught also in traps set in crevices between rocks loosened by the roots of hemlocks growing on the banks of Peters Creek near Gilboa. On Great Flat Top Mountain near Odd one was caught in a large Schuyler trap that had been nailed to the trunk of a beech tree, 5 or 6 feet above the base. Others were trapped under a dilapidated rail fence.

**Barbour County:** 7 miles east of Philippi, 2.

**Cabell County:** 5 miles east of Huntington, 3.

**Greenbrier County:** White Sulphur Springs, 19; Jobs Knob, 13 miles northwest of Renicks Valley, 1.

**Lincoln County:** Fourteen, 1.

**Mason County:** Mercers Bottom, 3.

**Mineral County:** Ridgeley, 5.

**Nicholas County:** Gilboa, 6.

**Pendleton County:** Franklin, 4.

**Raleigh County:** Redbird, 1; Marshes, 3; Odd, altitude 2,900 feet, 2.

**PEROMYSCUS MANICULATUS BAIRDII (Hoy and Kennicott)**

**PRAIRIE WHITE-FOOTED MOUSE**

The known range of this short-tailed mouse has now been extended eastward from central Ohio to the Panhandle of West Virginia. Two specimens collected by Karl W. Haller on March 24, 1937, along the Avalon-Bethany pike in Ohio County were submitted to the U. S. Biological Survey for identification by A. B. Brooks.

**PEROMYSCUS MANICULATUS NUBITERRAE Rhoads**

**CLOUDLAND WHITE-FOOTED MOUSE**

These long-tailed white-footed mice are most plentiful in the higher altitudes of the Allegheny Mountains. They are found generally on the drier hill slopes around rock crevices, stumps, rotten logs, brush piles, and the like. In the Cranberry Glades most of the specimens taken were trapped around rock slides on the mountain slopes. Some were caught in large Schuyler traps that had been nailed to the trunks of spruce and beech trees. In the vicinity of Cheat Bridge they were trapped at the entrances to holes in the moss covering the roots and base of trunks of spruce trees. Along Williams River they were most plentiful on the wooded hillsides. On Spruce Knob some were caught in the loose shale on the top of the Knob, others along rotten logs on the slopes, in runways in the moss at the bases of trees, and in traps

set for flying squirrels on the trunks of birch trees. On Flat Top Mountain, in the southern part of the State, they were trapped along fallen trunks of chestnut trees and also at the bases of living oak trees. Near Odd they were trapped only on the gravelly banks of a small stream flowing down the side of Flat Top Mountain. There was a rather thick growth of rhododendron on both banks of this stream.

**Greenbrier County:** White Sulphur Springs, 1.

**Pendleton County:** Spruce Knob, altitude 4,860 feet, 5.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 27; Travellers Rest, 10; Williams River, 12 miles west of Marlinton, 1.

**Raleigh County:** Odd, altitude 2,900 feet, 2; Flat Top, altitude 3,500 feet, 2; Winding Gulf, 4 miles southwest of Pemberton, 1.

**Randolph County:** Cheat Mountain, 3 miles west of Cheat Bridge, 4; Middle Mountain, 11 miles northeast of Durbin, 2.

#### NEOTOMA PENNSYLVANICA Stone

#### ALLEGHENY WOOD RAT

This wood rat occurs generally in the more remote parts of the mountains in eastern West Virginia, as well as in some of the northern and southern counties. It prefers rock ledges, caves, and rock slides, but so far as known it has never been taken in lowland swamps. The nests are generally made in a mass of vegetable rubbish consisting of sticks, leaves, nutshells, and the like on ledges or shelving rocks. At Philippi one was caught near a nest on a rock ledge exposed on a steep hill. There was also evidence that wood rats had been living in the rock crevices. Local residents believed that most of the wood rats in this area had died either of starvation or from the effects of the prolonged low temperatures during the winter of 1935-36. During June 1936 wood rats were trapped on a rock ledge at Cranberry Glades, but no nests were found. Two others were subsequently seen one night on these rocks. Newcombe (1930, p. 204) has made an ecological study of this wood rat in West Virginia, chiefly at Prices Rock near Madison in Boone County, at Mitchells Knob near Morgantown in Monongalia County, and at Cornwall's Cave near Masontown in Preston County. Robert C. Patterson (1933, 1934) also has published some observations on the habits of this wood rat. A. M. Reese (1934, pp. 44, 45, 47) records this wood rat from Lower Beaver Hole Cave in Monongalia County, Cornwall's Cave in Preston County, and Smoke Hill Cave in Pendleton County.

**Barbour County:** 4 miles east of Philippi, 1.

**Greenbrier County:** White Sulphur Springs, 16.

**Pendleton County:** Franklin, 11.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 2.

## SYNAPTOMYS COOPERI STONEI Rhoads

## STONE MOUSE LEMMING

This lemming is found in a variety of ecological situations, such as blue-grass pastures, old fields and hillsides, and sphagnum bogs. Near Gilboa one was trapped along an old rail fence bounding a dry field overgrown with broomsedge and grass about 50 yards from Peters Creek and at least 100 yards from a hemlock thicket. In an open forest of sugar maple, yellow birch, and spruce on a hillside about 30 yards from Cranberry Glades specimens were taken in runways under the matted leaves. On the side of Cheat Mountain one was caught at the entrance to a burrow in the moss growing around the base of a spruce tree. Another was found drowned in the C. C. C. camp reservoir on Black Mountain. Open woods and laurel thickets surrounded this reservoir.

The animal has been taken at White Sulphur Springs (Surber, 1909, p. 53) and also near a little woodland stream at French Creek, Upshur County (F. E. Brooks, 1911, p. 19).

**Nicholas County:** Gilboa, 1.

**Pocahontas County:** Black Mountain, Williams River, altitude 3,300 feet, 1; Cranberry Glades, altitude 3,300 feet, 2; near head of Cranberry River, 2; Travellers Repose, 4.

**Randolph County:** Cheat Mountain, 3 miles west of Cheat Bridge, altitude 3,900 feet, 1.

## CLETHRIONOMYS CAROLINENSIS (Merriam)

## CAROLINA RED-BACKED MOUSE

The records for this mouse are all in the eastern and southern mountainous portions of the State. At Odd, red-backed mice were trapped on a fairly dry hillside in runways under matted leaves near an old rail fence in a thicket of hemlock and laurel. One was caught in a trap set in a runway in a wet meadow at Cranberry Glades, where numerous moss mounds on the roots of trees were growing. This mouse may have come from one of these mounds, for on Cheat Mountain, Middle Mountain, and Spruce Knob red-backed mice were trapped only at the entrances to burrows in the moss mounds on the roots of spruce and yellow birch.

**Greenbrier County:** Jobs Knob, 13 miles north-northwest of Renicks Valley, 1.

**Fendleton County:** Franklin, 8; Spruce Knob, 3.

**Pocahontas County:** Cranberry Glades, 24; near head of Cranberry River, 1; Travellers Repose, 45.

**Raleigh County:** Odd, 1.

**Randolph County:** Cheat Mountain, 3 miles east of Cheat Bridge, 7.

**MICROTUS PENNSYLVANICUS PENNSYLVANICUS (Ord)****PENNSYLVANIA MEADOW MOUSE, OR VOLE**

Meadow mice make long intricate runways in matted grass on uncultivated borders of fields, in wet meadows, or near streams in lowland pastures. In such locations these mice may be found in most parts of the State. On a high knob at Mercers Bottom that had not been inundated by the flood waters of the Ohio River, runways of these mice were found in grass and weeds along a fence at the edge of a cultivated field. Near Huntington the runways of a colony were found in a tangle of matted grass and briars on both sides of a small spring stream. Although the runways in the wet pasture divided by Muddlety Creek were flooded, the meadow mice were not driven away. At Philippi meadow mice were trapped in runways on the gentle slope of a hill overgrown with broomsedge. Near Fourteen, a nest containing several young was thrown out by the plow on a hillside field below a hemlock grove. In Cranberry Glades most of these mice were caught in runways in the grass and moss growing between moss mounds in a wet meadow. Fred E. Brooks (1911, p. 18) reports that he had trapped one within a few yards of the summit of Spruce Knob, Pendleton County, or approximately 4,650 feet altitude.

**Barbour County:** 7 miles east of Philippi, 1.

**Cabell County:** 5 miles east of Huntington, 6.

**Greenbrier County:** White Sulphur Springs, 4.

**Lincoln County:** Fourteen, 1.

**Mason County:** Mercers Bottom, 2.

**Nicholas County:** Muddlety, 1; Gilboa, 1.

**Pendleton County:** Franklin, 3.

**Pocahontas County:** Cranberry Glades, 21; Travellers Repose, 2.

**Wayne County:** Ceredo, 1.

**MICROTUS CHROTORRHINUS CAROLINENSIS Komarek****SMOKY MOUNTAIN ROCK VOLE**

Although at present known to occur only at Cranberry Glades, this vole may be found to inhabit similar isolated areas throughout the Allegheny Mountain region of West Virginia. Cranberry Glades is a natural basin about half a mile in length and a quarter of a mile in width. Blueberry, cranberry, and sphagnum are among the conspicuous plants growing here. E. A. Preble, in November 1909, obtained a number of rock voles about an eighth of a mile south of this basin in a mixed, fairly open forest of beech, maple, and oak on a gentle slope at the base of Kennison Mountain. They were trapped at the entrances to little burrows in the moss that filled the intervals between rocks embedded in the ground. No runways were found.

Average of nine males: Total length, 156.1 (150-162); tail vertebrae, 51.6 (46-60); hind foot, 20.3 (20-21); condylobasal length of skull,

26.4 (24.8–27.5); occipitonasal length, 26.3 (24.9–27.5); basilar length Hensel, 23.6 (22–25); nasal length, 7.4 (7.1–7.7); zygomatic breadth, 15.1 (14.5–15.8); interorbital constriction, 3.7 (3.7–3.9); shelf of bony palate, 13.6 (12.8–13.7); height of cranium at bullae, 9.5 (9–10.5); mastoid width, 12.6 (12–12.9); length of upper molar series, 6.5 (6.3–6.8); and length of mandible, 16.1 (15.7–16.6).

Average of six females: Total length, 152.8 (150–169); tail vertebrae, 45.6 (43–50); hind foot, 20.1 (20–21); condylobasal length of skull, 26.7 (26–27.2); occipitonasal length, 26.6 (21.1–27.2); basilar length Hensel, 24 (23.6–24.4); nasal length, 7.3 (7–8); zygomatic breadth, 15 (14.8–15.2); interorbital constriction, 3.7 (3.6–3.9); shelf of bony palate, 13.3 (12.8–13.8); height of cranium at bullae, 9.4 (9.1–9.7); mastoid width, 12.6 (12.3–12.9); length of upper molar series, 6.4 (6.2–6.6); and length of mandible, 16.2 (15.9–16.5).

**Pocahontas County:** Cranberry Glades, 23; Millpoint, 1.

**PITYMYS PINETORUM SCALOPSOIDES (Audubon and Bachman)**

**NORTHERN PINE MOUSE**

The pine mouse is a burrower, spending most of its life in underground runways. As the name implies, it seems to show some preference for woodlands, especially pine woods. It is frequently found, however, along the borders of cultivated fields, meadows, and pastures adjoining woods, and occasionally in wet bottomland timber. Along Peters Creek, near Gilboa, pine mice were trapped in runways under dry matted leaves near an old rail fence in a growth of hemlocks.

F. E. Brooks (1911, p. 18) records this mouse from Morgantown, Monongalia County; Terra Alta, Preston County; French Creek and Buckhannon in Upshur County; and Peterstown, Monroe County.

**Greenbrier County:** White Sulphur Springs, 11.

**Nicholas County:** Gilboa, 2.

**Putnam County:** Raymond City, 1.

**ONDATRA ZIBETHICA ZIBETHICA (Linnaeus)**

**COMMON MUSKRAT**

According to A. B. Brooks (1929, p. 544) the muskrat inhabits streams and marshes throughout the State. The National Museum party did not collect any specimens. Tracks were seen along the Ohio River above Point Pleasant, Mason County. Those living along Muddlety Creek on the Tinnel farm were driven away apparently by spring floods in 1936. Similar conditions seemed to prevail along Sugar Creek south of Philippi in Barbour County. Hollister (1911, p. 18) records four specimens from White Sulphur Springs, Greenbrier County.

## Family MURIDAE

## RATTUS RATTUS RATTUS (Linnaeus)

## BLACK RAT

Though the black rat was probably the first introduced rat to reach West Virginia, in most localities where it formerly occurred it has been driven away by the Norway rat. Writing from the vicinity of Wellsburg, Brooke County, W. Va., Doddridge (1824, p. 71) makes the following statement: "Rats which were not known here for several years after the settlement of the county, took possession of it, in its whole extent, in one winter season." Specimens were collected by Thaddeus Surber at White Sulphur Springs in 1897.

Greenbrier County: White Sulphur Springs, 1.

## RATTUS NORVEGICUS (Erxleben)

## NORWAY OR HOUSE RAT

This introduced rodent is the common destructive rat of warehouses and alleys and is likewise a nuisance around barns and grain cribs on farms.

## MUS MUSCULUS MUSCULUS (Linnaeus)

## HOUSE MOUSE

The familiar house mouse apparently came to West Virginia in boxes containing supplies for the early settlers.

Mason County: Mercers Bottom, 1.

Pendleton County: Franklin, 1.

## Family ZAPODIDAE

## NAPAEZAPUS INSIGNIS INSIGNIS (Miller)

## WOODLAND JUMPING MOUSE

The woodland jumping mouse has been recorded (F. E. Brooks, 1911, p. 19) from French Creek, Upshur County. There are no specimens collected in West Virginia in the National Museum.

## NAPAEZAPUS INSIGNIS ROANENSIS (Preble)

## ROAN MOUNTAIN WOODLAND JUMPING MOUSE

This jumping mouse is partial to deep woods, especially near running streams. On the south fork of Cranberry River, Cranberry Glades, one was trapped on a stump in a forest of spruce, sugar maple, and yellow birch. Another one was caught on Cheat Mountain in a trap set at the entrance to a small burrow in a moss mound growing on the roots of a spruce tree. On Spruce Knob in a dense forest of spruce, sugar maple, and yellow birch, two jumping mice were trapped at entrances to burrows in the moss growing in the inter-

vals between rocks. This form is smaller and darker than the typical *insignis*.

**Greenbrier County:** ? White Sulphur Springs, 1.

**Pendleton County:** Spruce Knob, 2.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 1.

**Randolph County:** Cheat Mountain, 3 miles west of Cheat Bridge, altitude 3,900 feet, 1.

It has been recorded (F. E. Brooks, 1911, p. 19) also from Turkey-bone Mountain, 2 miles south-southeast of Pickens, Randolph County.

#### ZAPUS HUDSONIUS HUDSONIUS (Zimmermann)

##### NORTHERN JUMPING MOUSE

This jumping mouse occurs in meadows and wet fields overgrown with shrubs in the area drained by the Ohio River and its tributaries. The specimen (U. S. N. M. no. 18442) listed by Preble (1899, p. 17) as coming from Wheeling, W. Va., was actually collected by E. Walton Hennig at Portland Station, Meigs County, Ohio. The animal has been recorded, however, by F. E. Brooks (1911, p. 19) from French Creek in Upshur County and Sherrard in Marshall County.

#### Family ERETHIZONTIDAE

##### ERETHIZON DORSATUM DORSATUM (Linnaeus)

##### AMERICAN PORCUPINE

From time to time porcupines have been killed in the pine forests on the lower ridges of Spruce Knob, Pendleton County. They have never been very plentiful in the memory of present residents of that area. Fred E. Brooks (1911, p. 20) reports that one was killed near Morgantown, Monongalia County.

#### Family LEPORIDAE

##### LEPUS AMERICANUS VIRGINIANUS Harlan

##### VIRGINIA VARYING HARE

This hare seems to prefer dense forests where thickets and brush abound, and especially tracts of woods broken by open glades. It is seldom found in woodland devoid of underbrush. During the summer months it frequents the dense "dark pine patches" on the higher points of the Allegheny Mountains where the rays of the sun do not penetrate. According to Fred E. Brooks (1911, p. 21), hunters reported that the varying hare was abundant in places on Shavers Mountain and also on Black Mountain, Pocahontas County, and that a number had been seen in Canaan Valley, Tucker County. During the summer of 1936, however, residents in Pocahontas and Randolph Counties reported



that the animals had been rather scarce during the past two seasons. It was assumed that they had been depleted in numbers by a periodical epizootic. One was caught on June 13, 1936, in Cranberry Glades in a large Schuyler trap baited with bacon.

**Pocahontas County:** Cranberry Glades, altitude 3,300 feet, 1; no definite locality, 1; Travellers Repose, 1.

**SYLVILAGUS FLORIDANUS MALLURUS (Thomas)**

**EASTERN COTTONTAIL**

Cottontails occur in the northern, eastern, and some of the southern counties. During the summer of 1936 they were fairly common in the laurel thickets along the north and south forks of the Cranberry River as far east as The Glades. The vertical range of the species extends to at least 3,300 feet in the region around The Glades. Farther north, in Randolph County, cottontails appeared to be rather scarce.

**Greenbrier County:** Roncoveerte, 2.

**Pendelton County:** Franklin, 2.

**Pocahontas County:** Cranberry Glades, 2.

**Raleigh County:** Beckley, 1; Marshes, 1; Masseysville, 1.

**Wetzel County:** Earnshaw, 8; no definite locality, 1.

**SYLVILAGUS FLORIDANUS MEARNSHI (Allen)**

**MEARNS COTTONTAIL**

Cottontail rabbits from the western and central portions of West Virginia were referred to this race by Nelson (1909, p. 160), although no specimens were then available for comparison. During the summer of 1936 cottontails were collected by the Museum party in four of these counties. These specimens are paler and the upperparts are more grayish and less noticeably pinkish buff than is the case with specimens of *S. f. mallurus*. The tympanic bullae, also, are slightly smaller. The ears, however, do not average shorter nor do the hind feet average longer. This cottontail is most abundant in abandoned farm fields overgrown with weeds and brush. It is a woodland species but is not found in dense forests or open fields.

In the vicinity of Mercers Bottom cottontails were found in brier thickets bordering cultivated fields in the bottomland along the Ohio River. Near Huntington they were rather common in brier patches in fields overgrown with broomsedge and weeds, as well as in open deciduous woods in the bottomlands along the Guyandotte River. At Gilboa cottontail rabbits were found in the rhododendron and laurel thickets bordering uncultivated fields along Peters Creek. Near Philippi they seemed to prefer the brier patches in open deciduous woods.

Three full-term fetuses were taken from a female killed on April 20, 1936, near Huntington.

Barbour County: 7 miles east of Philippi, 2.

Cabell County: 5 miles east of Huntington, 2.

Mason County: Mercers Bottom, 1.

Nicholas County: Gilboa, 2.

*SYLVILAGUS TRANSITIONALIS* (Bangs)

NEW ENGLAND COTTONTAIL

The range of this cottontail extends southward through West Virginia in the Allegheny Mountains. It is a forest-inhabiting species, preferring tracts with dense underbrush. Specimens collected by A. B. Brooks (1929, p. 544) in Morgan County in 1915 were identified as this species.

Greenbrier County: Ronceverte, 1; White Sulphur Springs, 2.

Morgan County: Great Cacapon Mountain, 2.

Pocahontas County: Travellers Repose, 2.

Family CERVIDAE

*ODOCOILEUS VIRGINIANUS VIRGINIANUS* (Boddaert) and *ODOCOILEUS VIRGINIANUS BOREALIS* Miller

WHITE-TAILED DEER

Deer seem to have been plentiful for many years after the arrival of the early settlers. Their skins were used by hunters and settlers for clothing and moccasins, and thousands were sold to traders. Deer skins "in the hair" were valued by the traders in 1763 at 18 pence a pound. The first attempts to restrict the killing of deer seem to have been made as early as 1801. During that year in Pendleton County killing between January 1 and August 1 was prohibited, the fine for such an offense being \$5 (Morton, 1910, p. 356).

Fred E. Brooks (1911, p. 11) concludes that the native deer belong mostly to the northern subspecies, and it is likely that this race did occur in the mountains of eastern West Virginia. The ranges of northern races of other mammals do extend southward in the Allegheny Mountains. The Virginia race, however, may have ranged over the lowlands of Greenbrier County, the lower Kanawha Valley, and the Ohio and its smaller tributaries.

Numerous references to deer appear in the journals of early traders and hunters. The earliest record for deer in West Virginia appears to be one mentioned in Fallam's journal (Bushnell, 1907, p. 51). This deer was killed during September 1671 near the falls of Great Kanawha River. Gist (Darlington, 1893, pp. 72, 142) records that he killed deer during January 1752 in Marshall County. Colonel Croghan (1831, p. 260) states that many deer were seen in May 1765 along the Ohio River between the mouth of the Little Kanawha

River and the Big Bend. In 1768 and for some years afterward deer were quite common along Hackers Creek in Harrison County (McWhorter, 1915, p. 80). George Washington refers in his journal (Sparks, 1839, p. 112) to the abundance of deer near the mouth of the Great Kanawha River on October 5, 1770. The Rev. David Jones writes in his journal (1865, p. 27) under date of December 16, 1772, that Mr. Owens killed several deer near the mouth of the Little Kanawha River. Historical accounts of West Virginia counties contain other references to the former abundance of deer. Brooks (1911, p. 12) mentions one hunter who had killed 600 deer.

It is believed that native white-tailed deer still exist in Pendleton, Randolph, and Pocahontas Counties. Nevertheless, West Virginia has introduced deer from other States into many of its forests. During the summer of 1936, deer were fairly common on Cheat Mountain, but only a few were reported to occur on Middle Mountain. Calculations based on tally counts made during periodical drives on twelve 160-acre plots within the Monongahela National Forest indicate, according to Arthur A. Wood, forest supervisor, a mean abundance of 1 deer to each 108 acres in middle and southern Pocahontas County, but only 1 deer to each 420 acres for the entire forest.

**Greenbrier County:** Meadow Creek Mountains, 5 miles northeast of Shryock, 1.  
**Preston County:** Rowlesburg, 1.

#### CERVUS CANADENSIS CANADENSIS Erxleben

##### EASTERN ELK, OR WAPITI

So far as can be ascertained from printed records, native elk disappeared from West Virginia at least 65 years ago. Elk were present throughout the State at the time when the first settlers arrived. In 1671 Sir William Berkeley sent a small exploring party (Brodhead, 1853, p. 193; Bushnell, 1907, p. 46) under the command of Thomas Batts and Robert Fallam to explore the country west of the settlements in Virginia. According to Beverley (1705, book 1, p. 64) "they set out together from Appomattox [near Petersburg], and in seven days' march reach'd the foot of the mountains. The mountains [Blue Ridge] they first arriv'd at, were not extraordinary high or steep; but, after they had pass'd the first ridge, they encounter'd others, that seem'd to reach the clouds, and were so perpendicular and full of precipices, that sometimes in a whole day's march they could not travel three miles in a direct line. In other places they found large level plains and fine savanna's three or four miles wide, in which were an infinite quantity of turkies, deer, elks, and buffaloes, so gentle and undisturbed, that they had no fear at the appearance of the men; but would suffer them to come almost within reach of their hands."

The next mention of elk in West Virginia is found in the journal of Christopher Gist (Darlington, 1893, p. 77). Gist writes under date

of March 6, 1752, that a herd of 30 elk were seen near a cave on Neemokeesy [=Fishing] Creek in Wood County and that one was shot. According to Kercheval (1833, p. 265) elk were plentiful in 1763 in the vicinity of Muddy Creek and Big Levels settlements in Greenbrier County. Three elk were killed that year by Archibald Glendennin for an Indian feast, following which the settlers were massacred. Withers (1831, p. 168) writes that elk were killed in 1777 on the Little Kanawha River. Early settlers shot elk in Harrison County along Hackers Creek near West Milford on West Fork River and also in the mountains of Randolph County (McWhorter, 1915, pp. 80, 81). According to Hale (1886, p. 62), the last elk was killed in Kanawha Valley in 1820 on Two Mile Creek, Elk River, about 5½ miles northeast of Charleston.

Between 1830 and 1835, elk were killed at a deer lick near "The Sinks" on Gandy Creek, a branch of the Dry Fork of Cheat River, Randolph County (Maxwell, 1898, p. 299). Three elk were killed on the Black Fork of Cheat River near Davis, Tucker County, in 1843 (Maxwell, 1898, p. 299). During 1845, seven elk were seen near Durbin, Pocahontas County (Brooks, 1911, p. 12). According to McWhorter (1915, p. 382) elk were last seen in Canaan Valley, Tucker County, about the time of the Civil War. McWhorter (1915, p. 382) states that an elk was killed in 1867 at Elk Lick on Middle River, Pocahontas County, and that tracks of elk were seen near the headwaters of Cheat River not later than 1873.

The few elk now at large on the ridges in the eastern part of the State escaped 10 or 15 years ago from an enclosure near Marlinton, Pocahontas County, belonging to the Allegheny Sportsmen's Association (Brooks, 1929, p. 538).

### Family BOVIDAE

#### BISON BISON PENNSYLVANICUS Shoemaker

##### EASTERN WOODLAND BISON

Although bison were abundant in West Virginia as late as 1780, it is rather surprising that only incidental reference is made to their presence in the journals and accounts left by explorers, hunters, and early settlers. The earliest record of bison within the present limits of West Virginia appears to be found in the account of an exploring expedition (Bushnell, 1907, p. 46; Alvord and Bidgood, 1912, pp. 183-205) that left the Virginia settlements near where Petersburg now stands on September 1, 1671. Thomas Batts, Thomas Wood, and Robert Fallam, who had been commissioned by Maj. Gen. Abraham Wood under authority of Governor Sir William Berkeley to explore the country to the west of the Virginia settlements, were accompanied by a servant, Jack Weason, and eight Appomattox

Indians. After crossing Craig, Potts, and Peters Mountains, the party traveled northwest across Monroe and Greenbrier Counties to the main branch of Gauley River and thence westward to the Great Falls of the Kanawha River in Fayette County. Reference (Beverley, 1705, p. 64) is made to the "infinite quantity" of bison and other game encountered by this party while crossing flat plains and savannas. There is traditional evidence according to Allen (1876, p. 86) "that buffaloes formerly passed eastward from the headwaters of the Great Kanawha River in West Virginia to the headwaters of the James River in Virginia."

In 1740, John Peter Salley was commissioned by the governor of Virginia to travel as far westward as the Mississippi River. Accompanied by two white assistants, Salley (Darlington, 1893, pp. 251-254) on March 16, 1742, set off from his home near Natural Bridge in Rockbridge County, Va., and traveled westward to the Greenbrier River, where five bison were killed. The hides were used to cover the frame of a boat, and the party continued on their journey.

The next mention of bison is found in the journal of Christopher Gist, who under instructions from the Ohio Company made an examination of lands in West Virginia bordering the Ohio River between the landing on the Monongahela River and the mouth of the Great Kanawha River. Gist (Darlington, 1893, p. 73) killed two bison on February 12, 1752, in Wirt County. On the return trip Gist (Darlington, 1893, p. 76) killed four bison on February 27, 1752, on the Lawwellaconin [=Pond Creek] in Wood County, W. Va.

In 1765 an English expedition commanded by Col. George Croghan was sent out to explore the Ohio River Valley and to conciliate the Indians. Leaving Fort Pitt on May 15, 1765, this party descended the Ohio River in two batteaux. Between the mouth of the Little Kanawha River and Buffalo Bottoms on the Big Bend of the Ohio River, Croghan writes in his journal (1831, p. 260) under the date of May 21, 1765, that buffalo, bears, deer, and all sorts of wild game were so plentiful that his party shot all they needed from the boats. Although no mention is made of the incident in the journal, Hale (1886, p. 62) states that Croghan encountered a vast migrating herd of buffalo crossing the Ohio River at Letart, Mason County, W. Va. In 1769, buffalo destroyed the crops of settlers on South Branch [=Hackers Creek] in Harrison County (Withers, 1831, p. 93).

During the years 1767 to 1769, settlers along the Buckhannon River killed bison in Barbour County (Withers, 1831, pp. 91-93). On October 5, 1770, George Washington found these animals in great abundance 14 miles above the mouth of the Great Kanawha River (Sparks, 1839, p. 112). The settlers killed seven bison on Elk Creek in Harrison County on January 1, 1772 (McWhorter, 1915, p. 381). Reference is made in the journal of the Rev. David Jones (1865, pp.

42-43) to the abundance of buffalo near the mouth of the Guyan-dotte River during January 1873. A few were still present in Greenbrier County as late as 1774 (McWhorter, 1915, p. 380). Again, in 1780, bison were so plentiful along the Little Kanawha River that Col. Daniel Brodhead sent hunters there to obtain a supply of meat for the garrison at Fort Pitt (Ellis, 1882, p. 86). Bison are reported to have been killed by settlers on Fishing Creek in Wetzel County in 1796 (McWhorter, 1915, p. 381). Although it has been stated (McWhorter, 1915, p. 381) that buffalo were not seen in the vicinity of Huntington, Cabell County, after 1805, Hale (1886, p. 62) writes that a buffalo was killed in 1815 on Little Sandy Creek, Elk River, about 12 miles northeast of Charleston, Kanawha County. According to Maxwell (1898, p. 300) a cow buffalo and her calf were discovered at a deer lick in Webster County about 1825. The settlers chased them with dogs. The calf was killed on Valley Fork of Elk River, and the cow was followed to Valley Head, Randolph County, where she was shot. This appears to be the last record for the State.

## LITERATURE CITED

ALLEN, JOEL ASAPH.

1876. The American bisons, living and extinct. *Mem. Kentucky Geol. Surv.*, vol. 1, pt. 2, ix+246 pp., 12 pls.

ALVORD, CLARENCE WALWORTH, and BIDGOOD, LEE.

1912. The first explorations of the trans-Allegheny region by the Virginians 1650-1674, 275 pp. Cleveland.

BEVERLEY, ROBERT.

1705. The history and present state of Virginia. Book 1, 10+104 pp.; book 2, 40 pp.; book 3, 64 pp.; book 4, 83 pp.; illus.

BRODHEAD, JOHN ROMEYN.

1853. The journal and relation of a new discovery made behind the Apuleian Mountains to the west of Virginia. Documents relative to the colonial history of the State of New York; procured in Holland, England, and France, vol. 3, pp. 193-197. Albany.

BROOKS, ALONZO BEECHER.

1929. Mammals of West Virginia. *The West Virginia Encyclopedia*, ed. 1, xxiv+1,052 pp. Charleston, W. Va.

BROOKS, FRED ERNEST.

1911. The mammals of West Virginia. *Rpt. West Virginia State Board Agr.*, no. 20 (for quarter ended Dec. 30, 1910), pp. 9-30.

BUSHNELL, DAVID IVES, Jr.

1907. Discoveries beyond the Appalachian Mountains in September, 1671. *Amer. Anthropol.*, vol. 9, no. 1, pp. 45-56.

CROGHAN, GEORGE.

1831. The journal of Col. Croghan. *Monthly Amer. Journ. Geol. and Nat. Sci.*, vol. 1, no. 6, pp. 257-272.

DARLINGTON, WILLIAM McCULLOUGH.

1893. Christopher Gist's journals with historical, geographical and ethnological notes and biographies of his contemporaries, 296 pp., illus. Pittsburgh.

DODDRIDGE, Rev. JOSEPH.

1824. Notes, on the settlement and Indian wars, of the western parts of Virginia and Pennsylvania, from the year 1763 until the year 1783 inclusive. Together with a view of the state of society and manners of the first settlers of the western country, xiii+15-316 pp. Wells-burgh, Va.

DOUTT, J. KENNETH.

1930. *Glaucomys sabrinus* in Pennsylvania. Journ. Mamm., vol. 11, pp. 239-240.

ELLIS, FRANKLIN.

1882. History of Fayette County, Pennsylvania, with biographical sketches of many of its pioneers and prominent men, 840 pp. Philadelphia.

HALE, JOHN PETER.

1886. Trans-Allegheny pioneers, historical sketches of the first white settlements west of the Alleghenies, 1748 and after, 330 pp., illus. Cincinnati.

HANNA, CHARLES AUGUSTUS.

1911. The wilderness trail, or the ventures and adventures of the Pennsylvania traders on the Allegheny Path with some new annals of the old west, and the records of some strong men and some bad ones, vol. 2, vi+457 pp., illus. New York and London.

HOLLISTER, NED.

1911. A systematic synopsis of the muskrats. North Amer. Fauna 32, 47 pp., 6 pls.

HOWELL, ARTHUR HOLMES.

1901. Revision of the skunks of the genus *Chincha*. North Amer. Fauna 20, 62 pp., 8 pls.

1906. Revision of the skunks of the genus *Spilogale*. North Amer. Fauna 26, 55 pp., 10 pls

1914. Revision of the American harvest mice (genus *Reithrodontomys*). North Amer. Fauna 36, 97 pp., 6 maps, 7 pls.

1918. Revision of the American flying squirrels. North Amer. Fauna 44, 64 pp., 4 maps, 7 pls

JACKSON, HARTLEY HARRAD THOMPSON.

1928. A taxonomic review of the American long-tailed shrews (genera *Sorex* and *Microsorex*). North Amer. Fauna 51, vi+238 pp., 24 figs., 13 pls.

JONES, Rev. DAVID.

1865. A journal of two visits made to some nations of Indians on the west side of the river Ohio, in the years 1772 and 1773, xi+5+127 pp. New York (reprinted for Joseph Sabin).

KERCHEVAL, SAMUEL.

1833. A history of the valley of Virginia, xlvi+47-486 pp. Winchester.

LEWIS, VIRGIL ANSON.

1912. History and government of West Virginia, 416 pp., illus. New York.

MAXWELL, HU.

1898. The history of Randolph County, West Virginia, 531 pp., illus. Morgantown.

McWHORTER, LUCULLUS VIRGIL.

1915. The border settlers of northwestern Virginia from 1768 to 1795 embracing the life of Jesse Hughes and other noted scouts of the great woods of the trans-Allegheny with notes and illustrative anecdotes, 509 pp., illus. Hamilton, Ohio.

- MILLER, GERRIT SMITH, JR., and ALLEN, GLOVER MORRILL.  
1928. The American bats of the genera *Myotis* and *Pizonyx*. U. S. Nat. Mus. Bull. 144, viii+218 pp., 13 maps.
- MORTON, OREN FREDRIC.  
1910. A history of Pendleton County, West Virginia, viii+493 pp. Franklin, W. Va.
- NELSON, EDWARD WILLIAM.  
1909. The rabbits of North America. North Amer. Fauna 29, 314 pp., 19 maps, 13 pls.
- NEWCOMBE, C. L.  
1930. An ecological study of the Allegheny cliff rat (*Neotoma pennsylvanica* Stone). Journ. Mamm., vol. 11, pp. 204-211, 1 map, 2 pls.
- PATTERSON, ROBERT COMPTON.  
1933. Notes on *Neotoma pennsylvanica* with special reference to the genital organization. West Virginia Univ. Bull., ser. 33, no. 15 (Proc. West Virginia Acad. Sci., vol. 6), pp. 38-42.  
1934. Habits of *Neotoma pennsylvanica*. West Virginia Univ. Bull., ser. 34, no. 15 (Proc. West Virginia Acad. Sci., vol. 7), pp. 32-35.
- PREBLE, EDWARD ALEXANDER.  
1899. Revision of the jumping mice of the genus *Zapus*. North Amer. Fauna 15, 42 pp., 4 figs., 1 pl.
- REESE, ALBERT MOORE.  
1934. The fauna of West Virginia caves. West Virginia Univ. Bull., ser. 34, no. 15 (Proc. West Virginia Acad. Sci., vol. 7), pp. 39-53.
- SPARKS, JARED.  
1839. The life of George Washington, xx+562 pp., illus. Boston.
- SURBER, THADDEUS.  
1909. Some remarks on the game mammals of West Virginia. With an annotated list of all species found in the State. Proc. 3d Annual Meeting West Virginia Fish and Game Prot. Assoc., pp. 49-56. Charleston, W. Va.
- WITHERS, ALEXANDER SCOTT.  
1831. Chronicles of border warfare, or a history of the settlement by the whites, of north-western Virginia: and of the Indian wars and massacres, in that section of the State; with reflections, anecdotes, etc., 319 pp. Clarksburg, Va.







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## ON THE DETAILED SKULL STRUCTURE OF A CRESTED HADROSAURIAN DINOSAUR

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A PARTIAL skeleton of a crested hadrosaurian dinosaur, collected by the Smithsonian Paleontological Expedition of 1928, is unique in having the occipital region of the skull disarticulated, thus displaying structural features not before observed in the Hadrosauridae. The specimen (U.S.N.M. no. 11893) comes from the Two Medicine formation of the Upper Cretaceous and was found by G. F. Sternberg on the north side of the Two Medicine River, Blackfeet Indian Reservation, Teton County, Mont. Although a considerable part of the skeleton was recovered, it is only the skull parts with which we are now concerned.

That this specimen pertains to the subfamily Lambeosaurinae is clearly indicated by the reduced number of vertical rows of teeth in the dentaries, the deep and nearly vertical suture between the frontal and nasal bones for the better anchorage of the crest, and the short, broad nature of the cerebral expansion of the brain as indicated by the frontal contribution to the brain case.

The lack of the crest portion of the skull and the juvenile character of the present individual make it very difficult if not impossible to identify this specimen generically at this time.

The detailed osteological structure of the occipital segment is the least-known part of the hadrosaurian skull, for in most crania the sutures are coalesced, thus obscuring or hiding entirely the precise extent of the individual elements

The present specimen, therefore, appears worthy of the detailed description that follows:

*Parietal*.—The coalesced parietals are much constricted between the supratemporal fossae, the posterior half presenting a thin median crest that rises to the level of the superior squamosal border. The anterior half is rounded transversely and widely expanded at the end, where it is in sutural contact with the whole posterior ends of

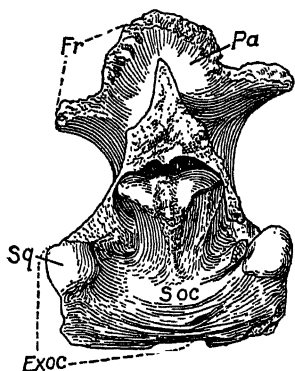


FIGURE 29.—Parietal (lacking posterior end) and supraoccipital (U.S.N.M. no. 11893), posterior view. *Exoc.*, sutural border for the exoccipital; *Fr*, sutural border for the frontal; *Pa*, parietal; *Soc*, supraoccipital; *Sq*, articular surface for squamosal articulation. One-half natural size.

the frontals and appears to meet the post-frontal on its outer anterior angle. At the center a broad rounded median prolongation is interposed between the frontal bones, as in *Lambeosaurus*. Posteriorly the slightly widened end of the parietal overhangs the supraoccipital and is suturally joined to the squamosals on either side. This end is visible from a posterior view, as in *Cheneosaurus* (see fig. 30). Ventrally the parietal sits astride the supraoccipital with which it is closely joined on the two sides (see fig. 29); anterior to the supraorbital it unites ventrally with the alisphenoid, but nowhere is it in contact with the prootic or the exoccipital, although Lambe was of the opinion that both of these bones articulated with the parietal in *Edmontosaurus*. He was certainly wrong in regard to the exoccipital, for I do

not know of any dinosaurian skull in which these two bones are in contact.

#### MEASUREMENTS OF PARIETAL

Greatest length along midline.....	71 mm
Greatest width across anterior end.....	66 mm
Greatest width across posterior end.....	15 mm

*Supraoccipital*.—The supraoccipital was found articulated with the overlying parietal, as shown in figure 29. Viewed posteriorly the supraoccipital is a subtriangular, blocklike bone that is enclosed above by the parietals and squamosals and that is in contact below with the exoccipitals. The broad, rounded, bilobed upper surface of the median crest of this bone is smooth and gives no indication of sutural union with the overlying parietal. It was evidently a cartilaginous union such as is commonly found in the Sauria. A similar condition exists in *Camptosaurus* and *Stegosaurus*. In aged individuals this surface may become coossified with the parietal, as is known to be the case in *Stegosaurus*. On either side well below the crest these two

bones meet in grooved sutural contact. Ventrally the supraoccipital presents two sutural surfaces that articulate with the exoccipitals. The posterior one is horizontal, the anterior face oblique looking outward, forward, and downward. On the posterolateral angles of this bone are raised smoothly rounded protuberances that look upward and articulate with a cupped surface developed on the lower border of the squamosal, as shown in figure 30. This rounded articular surface is contributed to laterally by the exoccipital.

This is a most unusual cranial articulation that gives every indication of being a movable union, although the other articulating surfaces of both squamosal and supraoccipital are through the medium of roughened sutural contacts. This ball and socket articulation may be present in all hadrosaurian crania, but through coalescence no trace of such a union has before been observed in this family or for that matter in other dinosaurian skulls. The ventral side of the supraoccipital, although slightly excavated at the center (see fig. 29), presents a continuous roughened sutural surface across the entire width of the bone, indicating that the exoccipitals meet on the median line and thus exclude the supraoccipital from participation in the boundary of the foramen magnum, as in *Bactrosaurus*.<sup>1</sup> This inward median extension of the one exoccipital bone present is broken off, so one has to rely on the continuous sutural surface as evidence of the condition described above, although corroborative evidence is furnished by the cross section of a skull figured by Brown,<sup>2</sup> which shows the exoccipital below the supraoccipital on the midline above the foramen magnum. This is a structural modification known at this time only in the hadrosaurian skull among the Dinosauria. Anteriorly the supraoccipital is deeply excavated, thus forming the posterior portion of the brain case. A heavy triangular-shaped sutural surface on the anterior border that looks forward and outward is the contact for the prootic.

#### MEASUREMENTS OF SUPRAOCCIPITAL

Greatest length.....	52 mm
Greatest transverse width.....	65 mm
Greatest vertical depth.....	42 mm

*Squamosal*.—The squamosals are separated on the median line by the interposition of a backwardly extended process of the parietal, which they meet by a strongly ridged and grooved suture. They are only 10 mm apart (see fig. 30). This union with the parietal continues downward and forward on either side of the upper median part of the supraoccipital. Ventrally it unites with the supraoccipital by a smooth cupped articulation, which rests upon the ball-like

<sup>1</sup>Gilmore, Charles W., Bull. Amer. Mus. Nat. Hist., vol. 67, p. 55, fig. 22, 1933.

<sup>2</sup>Brown, Barnum, Bull. Amer. Mus. Nat. Hist., vol. 33, pl. 36, 1914.

protuberance on the supraoccipital, to which the exoccipital contributes an outer portion. This articulation has been more fully described in connection with the supraoccipital. External to this cup the squamosal sends downward and outward a narrow, compressed, tapering process. In the articulated skull this process is closely applied posteriorly, especially at its upper end, to the paraoccipital process of the exoccipital, and they continue in apposition throughout their lengths.

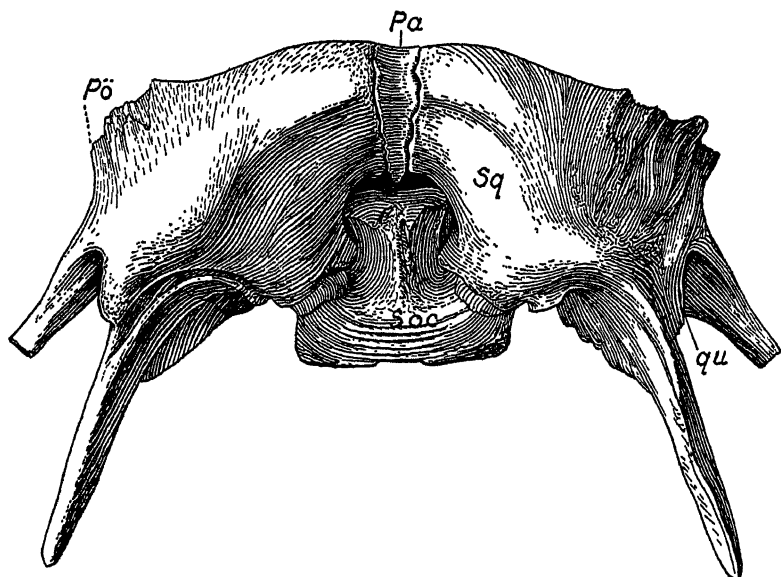


FIGURE 30.—Articulated squamosal, parietal, and supraoccipital (U.S.N.M. no. 11893). *Pa*, parietal; *qu*, cotylus for the quadrate; *Po*, sutural surface for articulation of postorbital; *Soc*, supraoccipital; *Sq*, squamosal. One-half natural size.

From a lateral aspect the squamosal presents a wide surface between its upper border and the top of the cotylus for the head of the quadrate. This is a peculiarity distinctive of all known members of the Lambeosaurinae, as the other members of the Hadrosauridae are relatively narrow in this view. The cotylus is deep. A pointed process of moderate length extends downward from its anterior border lapping along the front of the quadrate. Above and anterior to this process the squamosal is a short tapering process that unites by squamous union with the inner side of the postfrontal. The posterior overlap of the postfrontal is Y-shaped with the ventral branch much longer than the upper, as indicated by the sutural surfaces on the exterior surface of the squamosal. This same condition is found in *Lambeosaurus*, *Corythosaurus*, and *Saurolophus*.

## MEASUREMENTS OF SQUAMOSAL

Length from posterior border to anterior termination beneath the postfrontal.....	80 mm
Breadth from parietal contact, obliquely outward and downward to end of external process.....	150 mm
Depth from supratemporal fossa border to rim of cotylus..	52 mm

*Exoccipital*.—Only the left exoccipital is present, but it is in excellent preservation, as shown in figure 31. The exoccipital contributes extensively to the formation of the occipital condyle; a heavy posterior projection contributes nearly one-third of the complete condyle. The inferior horizontal surface unites with the basioccipital by a coarsely roughened sutural surface. Internally the surface is concave dorsoventrally forming the lateral boundary of the foramen magnum. This portion of the exoccipital is perforated by two foramina, which pass diagonally through the bone. The larger and more posterior is for the passage of the twelfth or hypoglossal nerve; the smaller anterior one for the eleventh or accessory nerve. The upper portion of the exoccipital has been described in connection with the supraoccipital.

The outer portion of this bone extends outward and backward and develops a large hooked paraoccipital process that in position lies against the squamosal process, which it supports and resembles in general shape. Its bluntly pointed extremity extends below that of the squamosal. On the inner end of the anterior side below the articulation of the supraoccipital a grooved subtriangular surface marks the union with the prootic (see fig. 31, B, *Pro*).

*Frontals*.—The coossified frontal bones are shown in figure 32. The frontals are of the typical *Lambeosaurinae* type; that is, much reduced in length, wider than long, and with a deep nearly vertical sutural surface for union with the nasals. This sutural area is nearly

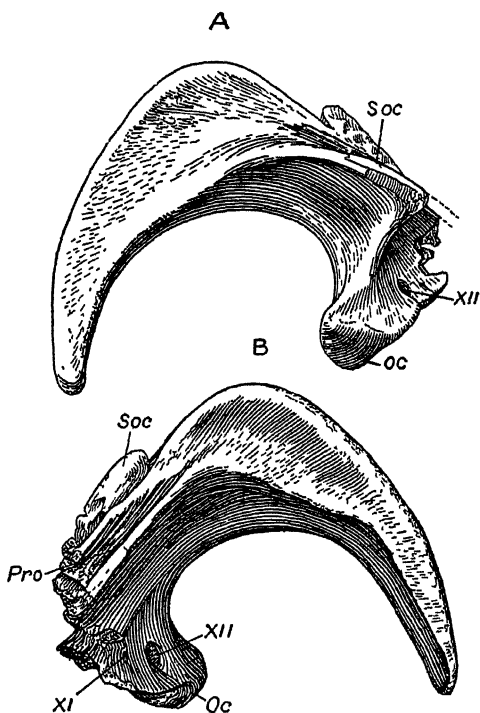


FIGURE 31.—Left exoccipital (U.S.N.M. no. 11893): A, Posterior view; B, anterior view. Oc, exoccipital contribution to the occipital condyle; Pro, sutural surface for union of prootic; Soc, articulating surface for union with the supraoccipital; XI and XII, foramina for the eleventh and twelfth nerves. One-half natural size.

one and one-half times the length of the dorsal surfaces of the frontals. It serves as a strong anchorage for the crest, which is missing in this specimen.

On the posterior border at the center the nasals are notched for a

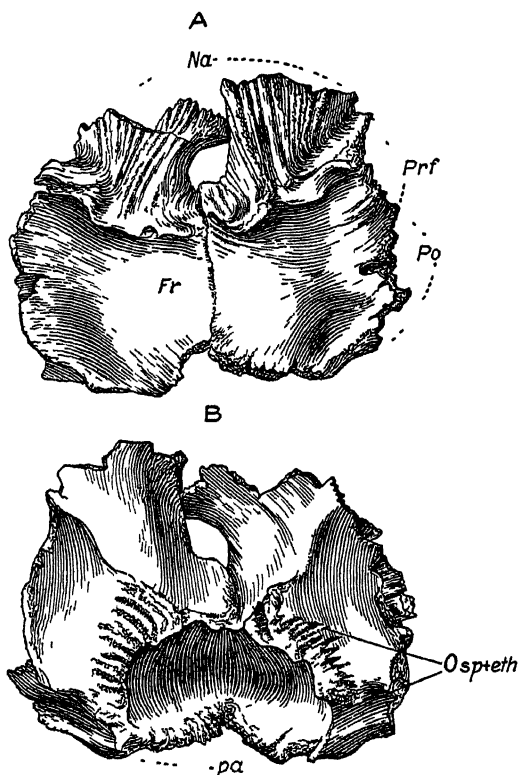


FIGURE 32—Articulated frontal bones (U S N M no 11893) A, Superior view, B, ventral view Fr, frontal, Na, sutural surface for articulation of nasals Osp+eth, sutural border for orbitosphenoid and ethmoid Pa, sutural border for parietal, Po, sutural border for postorbital, Prf, sutural border for prefrontal One half natural size

median forward projection of the parietal, but less deeply than in *Lambeosaurus*.<sup>3</sup> The ventral view (fig. 32, B) shows the very short but wide contribution to the brain case in which the cerebral portion of the brain was lodged. This feature is peculiar to the crested hadrosaurs and much unlike the elongate compressed cerebrum of *Thespesius*, *Edmontosaurus*, and presumably all non-crested forms of the Hadrosauridae.

The lateral borders are in contact throughout their whole length with the prefrontal and post-orbital, as shown in figure 32, and thus do not contribute to the formation of the orbital rim, as they do in the crestless hadrosaurs.

The illustration shows the bone as it is preserved, with a large foramen at the middle of the sutural slope. I am of the opinion that the left frontal has been crushed inward against the right element and that in the normal state there would be a deep gap between these two elements at this point. In *Lambeosaurus* there is a wide open notch.

The illustration shows the bone as it is preserved, with a large for-

#### MEASUREMENTS OF FRONTS

Greatest length dorsal surface on median line..	39 mm
Greatest width.....	107 mm
Depth of nasal suture ..	48 mm
Length of brain case.....	30 mm
Width of brain case.....	55 mm

<sup>3</sup> Gilmore, Charles W, Geol Surv Canada Bull 38, p 37, fig 8, 1924

*Postorbital*.—The element here designated postorbital is usually called postfrontal by authorities. It may represent a complex of these two elements, as in the theropodous dinosaurs, but in the present instance the alisphenoid articulates with it on the internal side, being received in a depression or pit. In those dinosaurian skulls in which prefrontal, postfrontal, and postorbital bones can be distinctly recognized, this cupped depression for the alisphenoid is always on the inner side of the postorbital bone, and it is largely for that reason that it is so designated here.

The postorbital has the usual triradiate form. Its posterior extension overlaps by squamous union the forward extension of the squa-

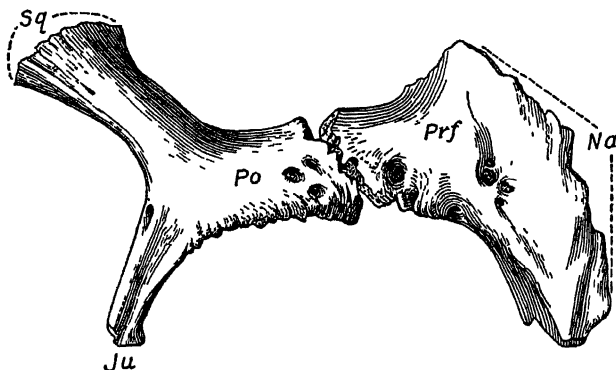


FIGURE 33.—Articulated postorbital and prefrontal bones (U S N M. no 11893), lateral view *Ju*, Process that unites with jugal, *Na*, inner side in contact with the nasal, *Po*, postorbital, *Prf*, prefrontal, *Sq*, process that unites with the squamosal. One-half natural size.

mosal and forms the supratemporal arcade separating the supratemporal from the infratemporal fossa. The posterior end is expanded dorsoventrally and on the inner side is deeply excavated for the squamosal process, which extends forward the full length of this bar. The anteriorly directed process is in contact internally by a zigzagged suture with the frontal for half its length. The heavy anterior end unites by suture with the prefrontal above the center of the orbit, as shown in figure 33. The descending bar, which is trihedral in cross section, united with an ascending process of the jugal by squamous union to form the postorbital bar. On the inner side at the junction of the three rays is a shallow rounded depression for the articulation of the outer end of the alisphenoid.

*Prefrontal*.—The prefrontal completes the upper border of the orbit articulating behind with the postorbital and in front with the lachrymal. Its upward extension is very thin and lapped the base of the elevated crest formed by the nasals as in *Cheneosaurus*. With the postorbital it excludes the frontal participation in the orbital rim, a peculiarity of the crested hadrosaurs, whereas in most of the crestless



forms it comprises a small portion of the border. The characteristic shape of this bone is well shown in figure 33.

*Prootic.*—Both disarticulated prootic bones are present, the left element in excellent preservation. The bone here called prootic in all probability represents the coossified prootic, epiotic, and opisthotic, certainly the last, for as in most reptiles these probably fused early in life, and thus all trace of their sutural junctions has long since been obliterated.

The prootic lies posterior to the alisphenoid and anterior to the exoccipital. Above it is in contact with the supraoccipital, below with the basisphenoid. In *Edmontosaurus*, Lambe<sup>4</sup> shows the prootic in contact with the parietal, and likewise Brown<sup>5</sup> in a trachodont brain case described by him found this complex in contact with the parietal. A similar condition exists in the crocodile skull. However, in the skull under consideration they are distinctly separated by the interposition of portions of the supraoccipital and alisphenoid bones. The pointed posterior half of this complex, probably the opisthotic portion on the inner side, presents two longitudinally ridged and grooved sutural surfaces, the upper one uniting with the supraoccipital, the lower with the exoccipital. This side is about equally divided between the two bones and overlaps the junction of the supraoccipital and exoccipital. The prootic proper is perforated by the foramen for the seventh or facial nerve. The anterior border is deeply notched by the foramen ovale for the fifth or trigeminal nerve, but the portion carrying the foramen for the eighth or internal auditory meatus is missing, and its position cannot be accurately determined in this specimen.

*Alisphenoid.*—The alisphenoid has the usual triangular curved form and lies in front of the prootic and bounds the large foramen for the trigeminal nerve in front. It connects superiorly with the parietal and frontal. The outer rounded end is received in a pit on the upper inner surface of the postfrontal+postorbital complex. This bone forms the wall of the brain case, which lodges the cerebral hemispheres.

The division between the alisphenoid and prootic is marked by a suture that descends from the floor of the supratemporal fossa and enters the foramen ovale forward of the upper curve of that opening. The external surface forms a part of the inner and anterior boundaries of the supratemporal fossa. A narrow groove on the external surface extending forward from the foramen ovale was for the reception of the ophthalmic branch of the fifth nerve. In form and relationships with surrounding elements this alisphenoid is in full accord with the conditions found in other hadrosaurian skulls. Anteriorly

<sup>4</sup> Lambe, L. M., Geol. Surv. Canada Mem. 120, p. 17, fig. 26, 1920.

<sup>5</sup> Brown, Barnum, Bull. Amer. Mus. Nat. Hist., vol. 33, pl. 36, 1914.

it unites with the orbitosphenoid, but their precise relationships are not clearly shown by this specimen.

*Orbitosphenoid*.—A pair of small subrectangular bones (see fig. 34, *Osp*) are identified as the orbitosphenoids. This identification rests to a considerable extent on the presence of several foramina that perforate these bones and that can be homologized with the nerve openings in the orbitosphenoid region in other Dinosauria crania. Unfortunately, the sutural edges have suffered from abrasion and crushing and thus offer little positive information as to their correct

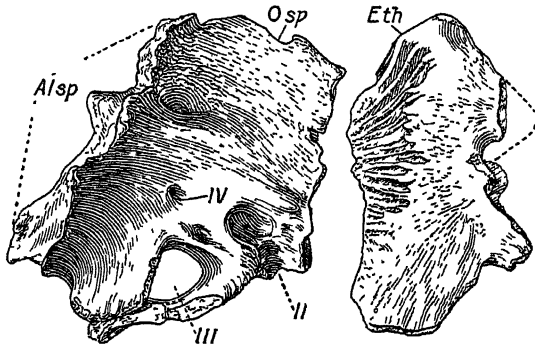


FIGURE 34.—Right orbitosphenoid and ethmoid (U.S.N.M. no. 11893). *Aisp*, sutural border for alisphenoid; *Eth*, ethmoid; *Osp*, orbitosphenoid; *I*, outlet for the olfactory nerve; *II*, the second or optic foramen; *III*, *IV*, foramen for third and fourth cranial nerves, respectively. Natural size.

relationships to the surrounding skull elements. A deeply grooved sutural border, having an extensive outer lip for squamous union, fulfills all requirements for a perfect articulation with the ethmoid and thus is regarded as the anterior edge of this bone. The superior edge is especially thickened for articulation with the overlying frontal. The posterior unites with the alisphenoid, and the ventral with the basioccipital, which is missing in this specimen. Since the basi-sphenoid and parasphenoid are both missing, it cannot be determined whether the orbitosphenoid was in contact with the parasphenoid. A small triangular sutural area on the lower anterointernal side of the orbitosphenoid appears to indicate a surface for union with its fellow of the opposite side on the median line below the forward part of the cerebral hemispheres.

The orbitosphenoid is perforated by a number of foramina identified as shown in figure 34.

The foramen for the optic nerve lies very close to the orbitosphenoid-ethmoid sutural border, and in this specimen it seems to be a notch or groove on the anterior ventral border of the orbitosphenoid with the ethmoid contributing to its boundary. It is quite possible that in better-preserved specimens an external view would

show the foramen as entirely enclosed within the orbitosphenoid bone.

Posterior to the optic foramen and separated by a wall of bone 8 mm in width is the foramen for the third nerve (see fig. 34). Immediately above the foramen for the third nerve are two small foramina one above the other. On the external surface a short shallow groove runs forward from each of these openings. It seems quite probable that the most ventral gave exit to the fourth or trochlear nerve. The superior one may have transmitted a blood vessel. On the ventral posterior border of the orbitosphenoid there is a shallow groove leading down to the sutural border which in the articulated skull may have led to the foramen for the abducent or sixth cervical nerve.

#### MEASUREMENTS OF ORBITOSPHEOID

Greatest length, anteroposteriorly..... 34 mm

Greatest height, dorsoventrally..... 48 mm

*Ethmoid*.—A pair of small subrectangular elements (see fig. 34) are identified as the ethmoids. In adult skulls the suture between the ethmoid and orbitosphenoid becomes so fully coalesced as to leave no trace of their union. In *Tyrannosaurus* Osborn<sup>6</sup> indicated the questionable presence of an ethmoid, and in describing the skull of *Edmontosaurus* Lambe<sup>7</sup> designated the lateral area immediately posterior to the exit of the olfactory nerves as being the presphenoid. In a brain case of *Saurolophus osborni* illustrated by Brown,<sup>8</sup> it now becomes evident, in the light of the present specimen, that the anterior portion of the element designated alisphenoid is the coalesced alisphenoid and orbitosphenoid and that the bone called presphenoid is the ethmoid. Other authors have considered all the brain case between the alisphenoid and exit for the olfactory nerves as being the orbitosphenoid bone. After comparison of the present specimen with the brain case of *Antrodemus*, *Camarasaurus*, *Triceratops*, *Stegosaurus*, *Thespesius*, and *Kritosaurus*, I am of the opinion that the ethmoid, although fused, is present in all these genera and probably in all Dinosauria.

Posteriorly the ethmoid unites with the orbitosphenoid, being received in a groove along the edge of the latter bone, which sends a wide thin process forward for a squamous overlap for one-half the width of the ethmoid, as shown in figure 34. In the left element this external sutural surface covers more than half the width of the bone. The strongly ridged and radiating nature of the suture renders the union of these two elements distinctive and thus contributes to the positiveness of their proper identification. The upper sutural end is widened transversely but constricted anteroposteriorly and thus

<sup>6</sup> Osborn, H. F., Mem. Amer. Mus. Nat. Hist., vol. 1, no. 1, figs. 8, 12, 1912.

<sup>7</sup> Lambe, L. M., Geol. Surv. Canada Mem. 120, p. 47, fig. 26, 1920.

<sup>8</sup> Brown, Barnum, Bull. Amer. Mus. Nat. Hist., vol. 31, p. 134, fig. 3, 1912.

has a limited contact with the frontal. The ventral third gradually thins toward the border with an outward inclination of the whole end. The slightly roughened inner surface of this end apparently indicates its lapping union with the missing parasphenoid. At about midlength on the internal side a low longitudinal ridge evidently marks the ventral limit of the olfactory lobes. Whether these ridges met on the median line, and thus formed the floor of this portion of the brain case, cannot be determined. There is no indication of a median bony septum, such as is present in *Tyrannosaurus*, and it would appear that in this form the ethmoids enclose an undivided cavity for the olfactory lobes of the brain and form an opening leading into the nasal and prenasal cavities in front of the orbits. In *Triceratops*<sup>9</sup> the ethmoidal region roofs over the olfactory lobes of the brain, a condition that could not possibly exist in this specimen.

## MEASUREMENTS OF ETHMOID

Greatest length, anteroposteriorly----- 24 mm

Greatest depth, dorsoventrally----- 44 mm

## SUMMARY

The study of this disarticulated brain case discloses for the first time in the Hadrosauridae the presence of a distinct ethmoid bone; the presence of a semimovable articulation between the squamosal, supraoccipital, and exoccipital; and contributes evidence that in this family the supraoccipital is excluded from participation in the boundary of the foramen magnum.

<sup>9</sup> Hay, O. P., Proc. U. S. Nat. Mus., vol. 36, p. 102, pl. 2, 1909.





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## HYDROCORALS OF THE NORTH PACIFIC OCEAN

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HYDROCORALS comprise those coelenterates of the orders Stylasterina and Milleporina, which, belonging in the class Hydrozoa, are probably highly specialized offshoots of hydroid ancestors. As in the case of marine hydroids the sexual individuals are entirely different from the feeding polyps. In the Stylasterina, the only order represented in the north Pacific, the gonophore is developed in a cavity of the coenosteum, called the ampulla, which often causes a blisterlike convexity on the surface of the colony, or may be superficially invisible owing to its position below the surface. In all the north Pacific species, represented by adequate material, the ampullae are of two distinct sizes. The smaller have been arbitrarily called male ampullae without benefit of microscopic examination; while the larger, usually twice as broad as the male, have been called female. In some cases the latter are known to house ova or planula larvae. With possibly one exception, the two sorts do not occur on the same colony. In dealing with material that is usually desiccated and unfit for histological examination it would perhaps be preferable to employ such terms as major and minor ampullae instead of female and male. That so-called male ampullae are not undeveloped stages of the female is amply demonstrated by their frequently different form and crowded condition. In *Allopora polyorchis*, a typical case, there would not be sufficient space to allow the small ampullae to expand to the size of the major ampullae.

32 8 2  
The region covered by this report includes all the water north of a line drawn from the southern boundary of the United States (lat.  $32^{\circ} 30' N.$ ) to the southern end of Sakhalin Island (lat.  $46^{\circ} N.$ ). All tropical and subtropical species are therefore extralimital.

The material<sup>1</sup> upon which this paper is based is a part of the rich collection of Stylasterina in the United States National Museum, augmented by scattered specimens from other sources, chiefly the Hopkins Marine Station of Stanford University. The types of all the new forms are in the collection of the National Museum.

The following extralimital species have been figured: *Cryptohelia pudica* Milne Edwards and Haime, plate 64, figure 1; *Cryptohelia japonica* (Milne Edwards and Haime), plate 64, figures 2 to 4; *Cryptohelia gigantea*, new species, plate 64, figure 5; *Distichopora sulcata* Pourtalès, plate 74; *Distichopora gracilis* Dana, plate 75.

Systematics of the Stylasterina present difficulties peculiar to the group in addition to those apparently inherent in the Coelenterata. Material for the most part consists of the dried skeleton of the colony, frequently imperfect. There is a slight sexual dimorphism added to the pitfalls presented by variation due to environment and lineage. Even in alcoholic material the gastrozooids and dactylozooids are often invisible by retraction, while the contents of the ampullae have proved to be of no practical value in differentiating species. Finally, the structures available are all very small and must be studied and drawn under high magnification, illuminated by a beam of concentrated light. It scarcely needs pointing out that great care must be exercised in taking accurate measurements. Under these conditions the comparison of elements and evaluation of variations imposes a severe strain upon any but the strongest eyes. Such painstaking analysis is necessary before progress can be made in the natural history of this group. The papers of H. N. Moseley and Dr. Hjalmar Broch have set a standard of excellence that unfortunately only a few have tried seriously to equal. Much of the literature is vague and sketchy judged by modern standards and can not be relied upon in a critical study.

The north Pacific is far richer in indigenous species than the north Atlantic. *Stylaster gemmascens alaskanus* and *Allopora norvegica pacifica* are representative forms of two well-known Atlantic species.

<sup>1</sup> My thanks are due to the authorities of the U. S. National Museum for the privilege of studying its collections, to those of the Peabody Museum, New Haven, Conn., and the Museum of Comparative Zoology, Cambridge, Mass., for the loan of material for comparison, to Dr. Sixten Bock, of the Riksmuseum, Stockholm, for the loan of north Atlantic material and of literature, to Dr. Hjalmar Broch, of the Royal Frederick's University, Oslo, for the identification of Japanese and Okhotsk Sea material and for the loan of examples of several of his species, to Dr. T. Wayland Vaughan for material, chiefly *Distichopora*, to Dr. H. Hattori, Biological Laboratory, Imperial Palace, Tokyo, Japan, for the gift of a representative collection of Japanese Stylasterina, to Dr. Elisabeth Deichmann, Museum of Comparative Zoology, for aid in various ways, to Prof. G. E. MacGinitie for several photographs of specimens, and to E. F. Ricketts, of Monterey, Calif., for the types of *Allopora petroglyphia*.

But the other Stylasters and Alloporas appear to have no close counterparts in the Atlantic with the exception of a race of the widely distributed *Stylaster erimius* reported by Dr. Broch from the Okhotsk Sea. It is certainly premature to speculate on the distribution of the species found in the Okhotsk Sea, a region that has hardly been scratched by the dredge. *Allopora boreopacifica* is common to the Sea of Japan and the Okhotsk Sea. *Allopora scabiosa* has a closely related form in Sagami Bay (Hattori collection), but *Allopora solida* is not very closely related to any known species. It will hardly be surprising if *A. stejnegeri* and *A. brochi* are eventually added to the Okhotsk fauna.

So far as the western coast of the United States is concerned only five species are present: *Allopora californica*, *A. venusta*, *A. verrilli*, *A. porphyra*, *Errinopora pourtalesii*. No true *Stylaster* has yet been found.

I have also examined material from the region of the Galapagos Islands, which is well represented in the National Museum. This fauna has nothing to do with that of the north Pacific. If it points anywhere it is to the West Indian region. *Cryptohelia* is the dominant genus.

As a parenthetic observation on the distribution of the Stylasterina, the only species known to inhabit the Hawaiian plateau is *Stylaster sanguineus*. Probably *Distichopora violacea* also occurs, although I can find no record. These are shallow-water tropical forms. Although I was in constant and close touch with all the detailed and carefully planned deep-water dredging done by the *Albatross* in 1902, I do not recall a single specimen of deep-water *Stylaster*, such as occurs in the East Indies, or of any other hydrocoral for that matter. The great depths surrounding the Hawaiian group appear to constitute an effective barrier, although the planulae of *Stylaster sanguineus* are probably transported in warm surface currents. If the last observation is not true, the only alternative is to conclude that *Stylaster sanguineus* reached the Hawaiian group when those islands were part of a land mass extensive enough to afford a shallow-water path from some Indo-Polynesian center of dispersal. If such were the case it seems likely that species characteristic of depths of from 100 to 800 fathoms, such as *Cryptohelia*, would also have traveled along a "lower road."

In table 1 are listed all the *Albatross* dredging stations in the north Pacific at which the species described in this report were taken, with all pertinent data for each station, and species taken at each station.

The Stylasterina naturally occur on a bottom that provides some solid objects permanent enough to afford attachment for the colony. Yet the nature of this is not always apparent from the data recorded, as for instance station 2852, "black sand" (*Allopora campyleca*); sta-



tion 4302, "blue mud" (*A. campyleca*). The bottom record for station 4777 reads "fine gravel", yet a small colony of *Allopora verrilli* and two of *Errinopora nanneca* (also three species of encrusting bryozoans) were growing on a very hard pebble 50 by 30 by 25 mm. Rocks, pebbles, and shells form the usual foundation whether or not there be mud, sand, or fine gravel accompanying. *Allopora campyleca* favors black sand or blue mud; while *Allopora boreopacifica* is found on pebbles in brown mud and fine black sand.

As regards temperature, the lowest is favored by *Allopora boreopacifica*, *A. norvegica pacifica*, and *Errinopora styliifera* at 29.8° to 32° F. Then there is a hiatus. From 37° (the probable temperature at station 3480) to 39° are found *Stylaster cancellatus*, *S. elassotomus*, *S. gemmascens alaskanus*, *Allopora campyleca* (and its subspecies *tylota* and *trachystoma*), *A. polyorchis*, *A. moseleyana* (and forma *leptostyla*), *A. stejnegeri*, *A. brochi*, *A. verrilli* (typical), *Cryptohelia trophostega*, *Errinopora nanneca*, *E. zarhyncha*, and *Distichopora borealis*. Between 41° and 44° is found *A. campyleca* not precisely typical nor yet well enough differentiated to show tangible characters. It is probable that *A. papillosa*, *A. verrilli*, and *A. petrograpta* occur here. Between 46° and 52° are found *A. campyleca paragea*, *A. venusta*, *A. californica*, *A. porphyra*, *Errinopora pourtalesii*, and at the lower limit *A. petrograpta*. *E. pourtalesii* ranges from the Strait of Georgia to south of Monterey Bay, and *A. californica* from the Farallone Islands to Lower California. Both species probably range into water warmer than 52°.

It is evident that station 3480 is a very favorable environment for hydrocorals, since there was dredged here a considerable bulk of material, comprising eight forms, some of which are massive. This station was in Amukta Pass, east of the Andreanof Islands of the Aleutian Chain, in 283 fathoms, rocky bottom with black sand. The Aleutian Islands form the crest of a very long, curved, mostly submarine mountain chain, which falls away to great depths on the south. It constitutes a partial barrier athwart Bering Sea, one of the sources of cold bottom water of the north Pacific. That bottom currents are present in the numerous passes of the Aleutian Chain is inevitable. Such water should be rich in oxygen and in planktonic organisms, or their dead remains.

The structure of the corallum of some Stylasters and Alloporas indicates that the species live where there is a gentle current predominantly in one direction. The peripheral branches are bent slightly toward the anterior face of the colony, which becomes slightly concave. Most of the gastrozooids are on the front and sides of branches, or on the sides only. Usually the back, presumably facing the current, is almost devoid of gastrozooids. This form of growth is also found in some species of *Cryptohelia*. The Alloporas of station 3480

evidently lived in a current but probably not a strong one; otherwise the bottom would be scoured free of sand.

This paper was submitted for publication prior to the receipt of Dr. Hjalmar Broch's "Untersuchungen an Stylasteriden" (1936). Through exchange of specimens I am fairly accurately informed concerning those of Dr. Broch's new species which should be included in

TABLE 1.—Albatross dredging stations at which hydrocorals were obtained

STATION	LOCALITY AND BEARINGS	DEPTH	NATURE OF BOTTOM	TEMPERATURE	SPECIES TAKEN
		<i>Fathoms</i>		<i>° F.</i>	
2852	Shumagin Islands, 55°15' N., 159°37' W.	53	Black sand.....	41.8	<i>Allopora campyleca</i> .
2858	Gulf of Alaska, 58°17' N., 148°36' W.	230	Blue mud, gravel---	39.8	Do.
2873	Off Cape Flattery, 48°30' N., 124°57' W.	40	Rocks.....	47.8	<i>Allopora venusta</i> .
2874	-----do-----	27	Rocks and shells....	50.3	Do.
2875	-----do-----	40	-----do-----	47.8	Do.
2888	Off Oregon, 43°58' N, 124° 57'30" W.	41	Coral and pebbles...	47.6	Do.
3050	Off Oregon, 44°01'15" N., 124°57' W.	46	Coral, broken shells.	46.1	Do.
3158	N. of Farallone Islands, Calif., 37°47'30" N, 123° 10'40" W.	29	Rocky.....	51.4	<i>Allopora venusta</i> , <i>A. californica</i> , <i>Errinopora pourtalesii</i> .
3159	N. of Farallone Islands, Calif., 37°47'20" N., 123° 10' W.	27	-----do-----	-----	<i>Allopora californica</i> , <i>Errinopora pourtalesii</i> .
3430	Amukta Pass, Aleutian Islands, 52°06' N., 171°45' W.	283	Black sand, coral, rocky.	-----	<i>Stylaster cancellatus</i> , <i>S. gemmascens alaskanus</i> , <i>Allopora campyleca</i> , <i>A. polyorchis</i> , <i>A. moseleyana leptostyla</i> , <i>Cryptohelia trophostega</i> , <i>Errinopora zarkhyncha</i> , <i>Distichopora borealis</i> .
3599	Bering Sea, N. of Rat Islands, 52°05' N., 177°40' E.	55	Rocky, fine sand, shells.	-----	<i>Allopora campyleca</i> , <i>Errinopora nananea</i> .
4230	Behm Canal, Alaska.....	240-108	Rocky.....	42.4	<i>Allopora campyleca</i> .
4245	Kasaan Bay, Prince of Wales Island, SE. Alaska.	95-98	Dark - green mud, sand, shells, rocks.	48.0	<i>Allopora campyleca paragea</i> .
4302	Off Shakan, Summer Strait, SE. Alaska.	212-169	Blue mud.....	44.2	<i>Allopora campyleca</i> .
4777	Petrel Bank, Bering Sea, 52°11' N., 179°49' E.	52-43	Fine gravel (coarse pebbles).	-----	<i>Allopora brochi</i> , <i>A. stefnegeri</i> , <i>A. verrilli</i> , <i>Errinopora nananea</i> .
4781	Off Agattu Island, 52°14'30" N., 174°13' E.	482	Fine gray sand, pebbles.	38.6	<i>Stylaster elassotomus</i> , <i>Allopora campyleca tylosa</i> , <i>A. moseleyana</i> , <i>Distichopora borealis</i> .
4784	Off East Cape, Attu Island, Aleutian Islands, 52°55' 40" N., 173°26' E.	135	Coarse pebbles.....	-----	<i>Allopora campyleca trachystoma</i> .
5016	Okhotsk Sea, off S. end of Sakhalin Island, 46°44' N., 143°45' E.	64	Brown mud, fine black sand, rocks.	29.8	<i>Allopora norregica pacifica</i> , <i>A. borcopacifica</i> , <i>Errinopora stylastera</i> .
5017	Okhotsk Sea, 46°43'30" N., 143°45' E.	64	Brown mud, black sand, pebbles.	-----	Do.

this report. Of *Allopora norvegica pacifica*, *A. boreopacifica*, and *Errinopora styliifera* I had already made illustrations. *A. scabiosa* and *A. solida* of the Okhotsk Sea were new to me, but it has not been deemed expedient to include figures of them at this late date since they have been fully treated in Dr. Broch's memoir.

#### GLOSSARY OF TERMS USED IN DESCRIPTIONS

- Ampulla:** The cavity in the coenosteum containing male or female gonophores or sexual members of colony. These often form blisterlike convexities on the surface.
- Coenosteum:** The hard calcareous substance that constitutes the skeleton of colony, in contradistinction to the animal tissue which forms it.
- Corallum:** The calcareous skeleton of the colony as a whole. (Hydrophytum of Hickson.)
- Cyclosystem:** The gastropore surrounded by a circle of dactylopores coordinated with it.
- Dactylopore:** The small pore into which the dactylozoid retracts.
- Dactylostyle:** Very tiny spicules along the wall of dactylopore.
- Dactylotome:** The shallow slits radiating from the margin of gastropore into which the dactylopores open.
- Dactylozoid:** The tentaclelike, mouthless member of the colony, armed with abundance of nettle cells, which accompanies the feeding individual or gastrozoid. (Pl. 70, fig. 2a.)
- Flabellum, flabellate, flabelliform:** Fan, fan-shaped, in reference to the form of the colony.
- Gastropore:** The central depression of a cyclosystem (or the larger pore when no cyclosystem is differentiated) into which the gastrozoid retracts.
- Gastrostome:** The mouth of the gastropore.
- Gastrostyle:** The upright spiculated projection at bottom of gastropore forming also a projection into the gastric cavity of the polyp.
- Gastrostylé chamber:** A very narrow space surrounding the gastrostyle and sometimes separated from the portion of gastropore above style by a cheval-de-frise of spicules.
- Gastrozoid:** The feeding polyp of the colony.
- Gonophore:** The sexual members of colony lodged in a cavity or ampulla. Male and female gonophores are on separate colonies.
- Planula:** The specialized gastrula larva that may sometimes be found in "mature" female ampullae. One of its peculiarities is the possession of an abundance of nettle cells in the ectoderm. (Mosley, 1879, pl. 42.)

#### Genus *STYLASTER* Gray

*Stylaster* GRAY, Zool. Misc., 1831, p. 36 (type: *Madrepora rosea* Pallas, 1766).

*Eustylaster* BROCH, Danish Ingolf-Expedition, vol. 5, pt. 5, p. 8, 1914 (type: *Madrepora gemmascens* Esper); Untersuchungen an Stylasteriden, pp. 9, 15, 1936.

*Stylaster* has been used in the traditional sense as a matter of convenience. I agree fully with Dr. Broch that there is no definite hiatus between *Stylaster* and *Allopora*. Admitting this, I feel that it is rather academic to reduce these time-honored groups to the status of subgenera and then to employ a trinomial designation for every

species as Dr. Broch has done. The inherent difficulty of allocating an annectant species to either *Allopora* or *Stylaster* is in no wise lessened when these groups are regarded as subgenera of an expanded *Stylaster*, although possibly one's sense of responsibility is a trifle lulled.

These remarks concern a point of view on a matter of usage. They are in no way intended as a criticism of Dr. Broch's truly epoch-making paper. It ranks with Moseley's classic as a standard work absolutely indispensable to future students.

I am, however, unable to agree with Dr. Broch in the matter of his new name *Eustylaster* for the subgenus *Stylaster*, *sensu stricto*. In the subdivision of a genus it seems to me to be axiomatic that the section that includes the original type species should retain the original generic designation.

STYLASTER ELASSOTOMUS, new species

PLATE 41, FIGURE 3; PLATE 12, FIGURES 1-1c; PLATE 49, FIGURE 1

*Diagnosis*.—Colony small, arborescent, not profuse, branching predominantly in one general plane; cyclosystems resembling those of *A. campyleca tylota* but with still shorter and very shallow dactylotomes; mouth of the dactylopore at extreme margin of the cyclosystem; dactylotome very short and shallow (pl. 42, fig. 1b). Type colony 60 mm high, 50 mm broad.

*Description*.—The colony is of the *Stylaster* type. There are no signs of coalescence of neighboring branches. The front of the colony is shown by plate 49, figure 1. The opposite side is devoid of cyclosystems, but there are a few male ampullae near the ends of the branches.

The cyclosystems are notable for the small size of the numerous dactylotomes (10 to 17) and the short distance they encroach vertically upon the gastropore wall. The vertical pores are relatively larger than in *A. tylota*, and the dactylostyle is usually conspicuous, although not always so much so as shown by the figure, which represents its maximum development. The gastropore is deep and normally curved; style slender, the style chamber differentiated by the presence of slender spicules protruding into its lumen in sharp contrast to the smooth walls of the pore above it. Diameter of cyclosystem 1 to 1.2 mm; depth of gastropore about 2 mm; gastrostyle 0.4 to 0.5 mm.

The male ampullae are scattered on the branches and are not numerous. They form low convex blisters, their surface being rougher and more porous than that of the surrounding coenosteum. Inner wall coarsely but not deeply fenestrated. Diameter of interior, which is oblate-spherical, 0.35 to 0.45 mm. Female ampullae not known.

The coenosteum is compact and hard, but the surface of trunk and base of branches is rougher than in *A. tylota*, being raised in low

vermiculations in the hollows of which are microscopic pores. On the smoother branches these pores appear as irregular, short sometimes branched slits, indicated in the drawing (pl. 42, fig. 1c). Other pores, about the size of the ordinary dactylopores, are scattered without order over the coenosteum.

Color of dried colony very pale buff, bleaching to white in hypochlorite solution. A second fragment is flushed with pale pink.

*Type*.—U.S.N.M. no. 43268.

*Type locality*.—Station 4781, off Agattu Island, Aleutian Islands, lat. 52° 14' 30'' N., long. 174° 13' E., 482 fathoms, fine gray sand, pebbles; bottom temperature 38.6° F.

*Specimens examined*.—The type colony and a fragment 50 mm long.

*Remarks*.—The structure of the colony resembles that of a specimen of *Stylaster profundiporus* Broch from Sagami Bay, Japan, but the likeness ends there. In *profundiporus* the dactylotomes are radially as long as the width of gastropore, which does not flare, trumpetlike, at the mouth. The dactylotomes cut deep in the wall of gastropore, and the intervening ridges between the dactylotomes are prominently decurrent on the sides of gastropore, as in *Allopora campyleca trachystoma*.

STYLASTER GEMMASCENS ALASKANUS, new subspecies

PLATE 47; PLATE 48; PLATE 54, FIGURE 2

*Diagnosis*.—Differing from *S. gemmascens* (Esper)<sup>2</sup> of the north Atlantic in the form of the prominent ampullae, which have an uneven rugose surface as if the wall were shrunk; and in the surface of coenosteum, which is thorny or traversed by fine ridges, sometimes decurrent from rim of cyclosystems. Colony flattened with a definite front and back, the majority of cyclosystems being on sides of branchlets, often at an angle so that the inner dactylotomes are destroyed or suppressed.

*Description*.—The characteristic form and posture of the cyclosystems are indicated by the figures (pls. 47, 48). The gastropore is usually funnel-shaped, broad at top, very narrow at bottom. There is a differentiated style chamber the top of which is marked by tiny spicules at about midheight of the slender spiculate gastrostyle. The upper flaring chamber of gastropore is about as deep as width of cyclosystem, or a little less. On the outside of the calyxlike cyclosystems are delicate decurrent ridges like the costae of madreporarian corals. These correspond to the septa between the dactylotomes.

The cyclosystems are usually asymmetrical in various ways. The greatest diameter measures 1 to 2 mm. Dactylopores 10 to 18, usually about 12; dactylotomes cut rather deep on sides of gastropore; gastrostyle very delicate, slender, inconspicuous, less than half as long as the gastropore axis.

<sup>2</sup> Broch, 1914, p. 8, pl. 1, figs. 4-7; pl. 2, fig. 16; pl. 3, figs. 21, 30; pl. 4, figs. 32, 33.

The ampullae are characteristic. The probable male ampullae are about 0.75 mm in diameter, about the same height, and the base is sometimes slightly constricted. The surface is very uneven (pl. 54, fig. 2; pl. 47; pl. 48, fig. 2). The probable female ampullae (pl. 47, fig. 3; pl. 48, fig. 1) are 1 mm in diameter. The surface is uneven, subrugose but less so than in the male, and there are no irregular protuberances such as usually characterize the male ampullae.

Coenosteum is of coarse texture. Surface of male fragments (e. g., pl. 48, fig. 2) is covered with unequal, compound, thorny outgrowths of very many different forms and sizes. These may form narrow, mostly longitudinal ridges on the face of colony, and also decurrent from the rim of cyclosystems. The surface of the female colony (pl. 47, fig. 3) is smoother, but on the peripheral branchlets are conspicuous smooth spiny outgrowths, sometimes extensions of septa of cyclosystems, sometimes independent.

Color of dried colony white or buffy white.

*Type*.—U.S.N.M. no. 43269.

*Type locality*.—Station 3480, Amukta Pass, Aleutian Islands, 283 fathoms, black sand, rocky.

*Specimens examined*.—Four fragments, three of which, including the type, are believed to be male and probably from the same colony; one believed to be female.

*Remarks*.—*Stylaster gemmascens* is recorded from such widely scattered localities as Indian Ocean (Milne Edwards and Haime), vicinity of Sulu Islands, 540 meters (Hickson and England), off Norway (G. O. Sars, Broch, and others). I have examined specimens from Trondhjemsfjord, kindly supplied by the Riksmuseum, Stockholm, through Dr. Sixten Bock. The United States National Museum possesses specimens from Norway (no. 15275). Now the species turns up along the Aleutian Islands, where the bottom water at 283 fathoms may be estimated, from readings at other stations, as between 37° and 38° F.

There is no precise information on the type specimen said to be in the Berlin Museum. Probably the *Siboga* specimen from off the Sulu Islands is very nearly typical, but Hickson and England (1905, p. 13) give no information on the ampullae. The north Atlantic specimens frequently have tubercles or blunt spines on the ampullae, but the walls are not strongly wrinkled as if badly shrunk, nor is the ampulla itself so prominent. So far as I can ascertain the surface of the coenosteum is not finely echinate or ridged as in the Alaskan form.

Quite apart from the improbability that a specific stock common to the north Pacific, north Atlantic, and tropical East Indies would be uniform, the fact remains that it is not homogeneous. Whether it is advisable to recognize geographical races depends upon viewpoint and whether implications of zoogeography are to be seriously regarded.

To state that the *same* species inhabits both the tropical East Indies and southern Bering Sea implies something vastly different from the statement that each region is occupied by a distinct race of the same species.

*Stylaster eximius* forma *minor* Hickson and England (1905, p. 11, pl. 1, figs. 7, 8) has been reported by Dr. Broch (1936, p. 22, fig. 3; pl. 1, fig. 3) from 1,076 meters, Okhotsk Sea. Dr. Broch's specimen differs from *alaskanus*, inter alia, in having a much shallower gastropore and a proportionately longer gastrostyle (Broch, 1936, fig. 3b). The style chamber is apparently not well differentiated. *S. g. alaskanus* has a much sturdier build and a rougher surface than *minor*, as indicated by figures of the type. All the *Siboga* specimens were taken in warm shallow water of the East Indies. It seems to me doubtful that this race would occur in the extremely cold water of Okhotsk Sea. At all events *Stylaster gemmascens alaskanus* is widely different from typical *S. eximius minor*.

STYLASTER CANCELLATUS, new species

PLATE 35, FIGURES 2-2c; PLATE 39; PLATE 40

*Diagnosis*.—Superficially resembling *Allopora polyorchis* but differing in its more delicate structure and its more freely anastomosing branches and branchlets devoid of spiny outgrowths; by its shallower and consistently funnel-shaped gastropores; and by the subspherical lumpy or corrugated female ampullae. Cyclosystems few on exposed surface of colony but relegated to lateral, protected face of branchlets.

*Description*.—As compared to *polyorchis* there are very few cyclosystems on exposed surfaces; rather they are crowded on the protected lateral face of the branchlets (pl. 39). These branches anastomose more freely than in *polyorchis* and the very irregular intervals of the net are often extremely narrow.

The gastropores average a little shallower than those of *polyorchis*, and the form is more often funnel-shaped (pl. 35, figs. 2, 2b, 2c) than the tubular form of *polyorchis* (pl. 35, fig. 1d). Where the branchlets are crowded and crooked the cyclosystems are quite asymmetrical in all sorts of ways. As in *polyorchis*, two or three gastropores may be surrounded by a series of dactylotomes, and in these (as well as in single distorted cyclosystems) the gastrostyle is likely to be thicker than in the normal symmetrical ones. From the branchlets that anastomose and form the net grow out very numerous short irregular twigs, which do not join another branch but help to fill in the available space between the already crowded branchlets. The terminal cyclosystem of such a twig is deeper and more symmetrical than the laterals usually are (pl. 35, fig. 2b).

The male ampullae are small, rounded-subconical, and densely crowded on both front and back of the branchlets, and overflow upon parts of the front of the principal stems; diameter 0.4 to 0.5 mm. The female ampullae are more spherical than in *polyorchis* and more decidedly rugose. The walls are deeply grooved, or the grooves are interrupted to form short irregular knobs connected by low ridges. The base of the ampulla is constricted, the wall thin, and the inner surface porous but not deeply fenestrated. Diameter of a female ampulla 0.75 to 0.85 mm, usually the latter.

Coenosteum smooth, hard, not appreciably different from that of *polyorchis* in texture. There are no thorny outgrowths.

Color pale buff, becoming pinkish buff after cleaning with sodium hypochlorite.

*Type*.—U.S.N.M. no. 43267.

*Type locality*.—Station 3480, Amukta Pass, Aleutian Islands, lat. 52° 06' N., long. 171° 45' W., 283 fathoms, black sand, rocky.

*Specimens examined*.—The type (fragment of female colony), the paratype, and two other fragments of a male colony.

*Remarks*.—This species has been contrasted with *Allopora polyorchis* since the two were taken at the same station and in early stages of my study were confused. However, *polyorchis* belongs to *Allopora* according to the standards now used to discriminate the group, whether as a genus or subgenus; *cancellatus* is very definitely not a form of *S. erimius*; nor do I believe it can be brigaded with *S. gemmascens*.

#### Genus ALLOPORA Ehrenberg

*Allopora* EHRENBURG, Abh. Akad. Wiss. Berlin, 1832, pp. 303, 371, 1834 (type: *Allopora oculina* Ehrenberg).

*Stylantheca* FISHER, Ann. Mag. Nat. Hist., ser. 10, vol. 8, p. 395, 1931 (type: *Stylantheca porphyra* Fisher).

#### ALLOPORA POLYORCHIS, new species

PLATE 35, FIGURES 1-1d; PLATE 37; PLATE 38

*Diagnosis*.—Colony large, flabellate, with robust anastomosing main stems, and very numerous irregular branches, some of which coalesce with neighbors, the very irregular interspaces being narrower than the branchlets. Cyclosystems crowded, often confluent on sides of branches, numerous but spaced on front, sparse on back. Cyclosystems resembling those of *A. campyleca* but smaller, the gastropores generally straight on exposed front and back of colony and style chamber differentiated by a circlet of spicules; female ampullae with slightly rugose walls.

*Description*.—For form of colony, see plate 37. Its greatest breadth is 390 mm; height about 280 mm. Anterior and posterior aspects well differentiated, the branchlets arising from anterolateral



face of main stems; the latter densely beset on back with short thorns. Both surfaces of branchlets crowded with small conical ampullae, but cyclosystems mainly on front and lateral aspects of stems and branches. Cyclosystems spaced 2 to 4 diameters apart on front of colony while on lateral aspect of branchlets they are crowded, often irregular, and sometimes confluent.

Cyclosystems slightly smaller than in *A. campyleca*, with usually 8 to 12 deep but not very long dactylotomes, fairly conspicuous dactylopores, and small dactylostyles. Gastropore often shallower than in *campyleca* and frequently not curved (though often set obliquely on the branchlets), so that the slender to moderately robust style can be seen surrounded by a series of delicate spicules projecting downward from the pore wall (pl. 35, figs. 1a, 1d). These slender spicules are not regularly present in *campyleca*, which thus does not have a sharply differentiated style chamber. Diameter of cyclosystems 0.75 to 1 mm; depth of gastropore about 0.8 to 1 mm; gastrostyle, 0.4 to 0.5 mm.

On the lateral faces of the branchlets the cyclosystems are often asymmetrical and broader than on the front. Sometimes two or three cyclosystems merge in such a way that a series of dactylotomes surrounds a depression at the bottom of which are two to four funnel-shaped gastropores (pl. 35, fig. 1c) or two separate styles may occupy the bottom of a gastropore.

Male ampullae similar to those of *campyleca*, very numerous, small, conical. The dorsal wall is thin and the cavity is 0.25 to 0.35 mm in diameter, its surface deeply pitted, sometimes rough. Female ampullae: The only fragment I feel any confidence in assigning to this form has scattered hemispherical ampullae with uneven wall as if the contents had shrunk (pl. 35, fig. 1b); diameter, 0.85 mm to 0.9 mm.

The coenosteum is closely similar to that of *campyleca*. In less exposed portions the surface becomes rougher and more porous. The main stems of type are very thorny.

Color, pale buff, usually becoming pale pinkish after cleaning with sodium hypochlorite.

*Type*.—U.S.N.M. no. 43266.

*Type locality*.—Station 3480, Amukta Pass, Aleutian Islands, lat. 52° 06' N., long. 171° 45' W., 283 fathoms, black sand, rocky.

*Specimen examined*.—The type and numerous fragments, not all of which are broken from the type colony.

*Remarks*.—*A. polyorchis* comes near to falling in *Stylaster*, in the vicinity of *S. cancellatus*, as the cyclosystems are crowded in series on the lateral face of the branches so closely as to be frequently confluent. But other cyclosystems, generally smaller than these lateral ones, are numerous on the front of the colony, though seldom con-

tiguous. This peculiarity of the lateral cyclosystems is not found in *campyleca* or any of its subspecies.

The cyclosystems of *polyorchis*, except some of the distorted lateral ones, are smaller than in *campyleca*, with a gastropore that is usually straight where the coenosteum is thick enough to allow it. The septa between dactylotomes are not continued as decurrent ridges down the sides of the gastropore as in the case of *campyleca*. In *campyleca* the gastropores on small branchlets remain deep and curved, and appear never to assume the form shown by plate 35, figures 1c and 1d. The style chamber is definitely differentiated in *polyorchis*. The female ampullae are slightly wrinkled (pl. 35, fig. 1b).

The style chamber is fairly well developed in *A. campyleca paragea*, but its cyclosystems are smaller, especially those of the lateral aspect of the branchlets, and they are not at all crowded after the manner of *polyorchis*. The male ampullae are not so prominent and pointed-conical as in *polyorchis*, nor are the female ampullae wrinkled.

ALLOPORA CAMPYLECA, new species

PLATE 34; PLATE 36

*Diagnosis*.—Colony large, subflabelliform, with anastomosing branches; color very pale buff; cyclosystems prominent, projecting, mostly on one face of colony; dactylopores 8 to 15, narrow; length of dactylotome about one-third diameter of cyclosystem; dactylostyle very small, scarcely emerging above inner lip of pore; gastropore deep, narrow, curved; gastrostyle slender, sharp; ampullae very numerous, superficial, forming blisterlike convexities, those of male colonies about the diameter of gastropore; those of female colonies about the diameter of medium-sized cyclosystems.

*Description*.—Colony large, subflabelliform, with massive branches, which may anastomose at base of colony; branchlets often abruptly smaller than main branches, slightly flattened, irregular, with cyclosystems irregularly along sides, as well as on the front. On the more convex posterior face of branches and branchlets there are but few cyclosystems, although the pustulate ampullae encroach upon the posterior surface of branchlets. The type fragment, which is evidently only a part of a larger colony, is 180 mm by 90 mm, the main stem being 25 mm in diameter.

The cyclosystems are subcircular but vary to broadly elliptical, especially on sides of peripheral branchlets, and are abruptly raised above the general surface of the coenosteum from one-third to one-half the diameter of the system—occasionally even more on peripheral branchlets. Dactylotomes 8 to 15, commonly 9 or 10, narrow, with subparallel sides, the radial dimension usually a little less than a third

of total diameter of system; ridges between dactylotomes decurrent on sides of gastropore. Dactylostyle very small and as a rule not extending above the mouth of the slit as seen on side of gastropore. Gastropore deep and characteristically slightly curved, so that the slender style at the bottom is generally completely hidden when the cyclosystem is viewed directly from above (pl. 34, figs. 1, 1b). Diameter of a cyclosystem 1 to 1.3 mm; depth 2 to 2.5 mm. Gastrostyle 0.5 to 0.6 mm long. In male colonies the gastrostyle is likely to be much slenderer (pl. 34, fig. 1c) than in female colonies (pl. 34, figs. 1f, 1g).

On the periphery of larger colonies, branchlets may become flattened and cyclosystems distorted. Dactylotomes are commonly longer on the distal side of such cyclosystems.

Male ampullae are ordinarily about the diameter of a gastropore; low hemispherical to low subconical, the latter when crowded. They occur on all sides of the branchlets although more numerous on front and back; but they are very scarce on the back of the main stems. Female ampullae are nearly or quite as broad as the cyclosystems and hemispherical in form. The dome-shaped roof is thin, typically quite smooth. The subspherical interior presents a fenestrated surface. The smaller branches of female colonies, with their cyclosystems protruding from among the blisterlike ampullae, suggest *Stenohelia* (pl. 34, fig. 1d).

The coenosteum is hard, but the surface is microscopically uneven and porous, the pores being in the bottom of sinuous anastomosing microscopic depressions and are best seen on the younger parts of colony. On some of the peripheral parts of the colony, especially the back and sides of branches, but without any uniformity of occurrence, there are scattered tiny papilliform protuberances. Certain others, similar in size, have a definite central pore, representing perhaps secondary dactylopores. The paucity of their numbers suggests their unimportance to the colony.

Color of dried colony, light buff to ochraceous-buff (Ridgway's nomenclature); when cleaned with sodium hypochlorite the coenosteum becomes dull white, sometimes with a suggestion of very pale pink.

*Type*.—U.S.N.M. no. 42870 (fragment of male colony).

*Type locality*.—Albatross station 3480, Amukta Pass, Aleutian Islands, lat. 52° 06' N., long. 171° 45' W., 283 fathoms, black sand, rocky.

*Specimens examined*.—Numerous fragments (male and female) from the type locality. Also from station 2852, 2 small specimens; station 2858, 3 small specimens, not typical; station 3599, 5 small fragments; station 4230, small fragment; station 4302, small fragment.

## ALLOPORA CAMPYLECA PARAGEA, new subspecies

## PLATE 41, FIGURES 1-1d; PLATE 43

*Stylaster (Allopora) boreopacificus* forma *typica* BROCH (in part), Untersuchungen an Stylasteriden, p. 56, fig. 17, c, d, pl. 8, pl. 9, pl. 10, figs. 24, 25, 1936.

*Diagnosis.*—Differing from *boreopacifica* of Japanese Sea in having much deeper gastropores, at the bottom of which is a differentiated style chamber, the dorsal orifice of which (at about midheight of the style) is generally bordered by spicules. Differing from *campyleca* in having smaller cyclosystems with 5 to 11, usually 7 or 8, dactylo-  
tomes; the narrow often curved gastropore typically flares slightly, trumpetwise, at the mouth.

*Description.*—The principal colony forms are as follows: *a*, Compressed arborescent, such as the male type specimen and a small female fragment from station 4245; *b*, flabelliform, with thick main trunks and slender twigs, as the colonies figured by Broch, and the very imperfect large specimen labeled "Alaska"; *c*, flabelliform, with broad main stems and short, thick, flattened branches, represented by a small female colony from Sitka. The photograph gives a fair idea of the habit of the type specimen. Although the whole colony is flattened and hence subflabellate, it is a flattened bush, since the branchlets form several layers, one behind the other, without any coalescence. There is a well-marked front and back, the cyclosystems being scarce on the back of the main stems and large branches. Height of colony 130 mm, greatest width about 125 mm, but it was much larger before the branches were broken; maximum front to back extent toward periphery about 60 mm; diameter of main trunk at base about 25 mm, of peripheral branchlets about 1.5 to 2 mm.

Cyclosystems average a trifle broader than in typical *boreopacifica* and measure 0.6 to 0.85 mm in diameter. They are hence narrower than in *campyleca*. They project slightly above the surface; are widely scattered on front of larger branches; are more numerous on the branchlets, especially on the lateral faces, but are nowhere crowded. Gastropore often rather flaring at mouth, below which it narrows, and is normally deep and slightly curved, narrowing toward the bottom, where the style chamber is slightly better differentiated than in *campyleca*. Gastrostyle medium slender, lanceolate in profile, sharp, about 0.5 mm long. As may be seen from the figures, the 5 to 9 or 10 dactylo-  
tomes are rather short, owing to the usually flaring gastrostome, on the sides of which the slits cut about as deeply as their length seen from above. The dactylopore is small, deep. In many systems the dactylostyle is rudimentary; in others it is fairly well developed, but does not extend above mouth of pore proper.

When the cyclosystem of the branchlets is viewed directly from above, the gastrostyle is hidden by the curvature of the gastropore, but on the larger branches the style can usually be seen.

The male ampullae are scattered irregularly on branchlets, between cyclosystems, and are similar to those of *campyleca*. As noted above there is a female colony (60 by 40 mm) with thickened branches (Sitka), and one 75 by 55 mm with slender branches mostly in one plane (station 4245). The female ampullae are hemispherical, smooth, and slightly larger than the largest cyclosystems, but the wall is obviously thicker than in *campyleca* and the chamber relatively smaller as a consequence. Diameter of an average female ampulla of *campyleca* 1.1 mm; thickness of wall 0.05 to 0.06 mm. In *paragea* the same dimensions are 0.85 to 1 mm, and 0.14 mm. The interior is pitted but there are no spicules.

The coenosteum is hard and the surface smooth. Under strong magnification it shows the characteristic vermiculations—low ridges and anastomosing microscopic grooves between them. Surface not porous after cleaning with sodium hypochlorite. There are scattered small dactylopores penetrating the coenosteum, often at the apex of a low elevation.

Color of dried colony creamy white (type), pale buff (Sitka, station 4245); pale pink ("Alaska").

*Type*.—U.S.N.M. no. 42871.

*Type locality*.—Near Juneau, Alaska (Tenakoe Springs). Depth and bottom not recorded. Specimen obtained by Dr. Willis H. Rich, of Stanford University.

*Specimens examined*.—In addition to the type, the following: Station 4245, 1 specimen, female; Sitka, Alaska, shrimp dredge, E. F. Ricketts, 1932, 1 specimen, female; Alaska, basal portion of large male colony and fragments of female colony; Alaska, Hans Jensen, 1 male specimen loaned by Dr. Hjalmar Broch (1936, p. 56).

*Distribution*.—Southeastern Alaska, Yakutat to Prince of Wales Island, in probably fairly shallow water to 95 fathoms.

*Remarks*.—This seems to be a southern shallow-water race of *campyleca*. The latter has been taken in deep water in southeast Alaska, but the specimens, though not typical, are nearer *campyleca* than *paragea*.

As I include all Dr. Broch's Alaskan specimens of *boreopacifica* forma *typica* in *paragea*, I should explain that I believe *paragea* has a different lineage from true *boreopacifica*, as exemplified by the type from St. Olga Bay, northeast of Vladivostok, Japan Sea. This conclusion is strengthened by a study of a form of *boreopacifica* from very cold water of Okhotsk Sea, recorded in this paper. The resemblance between *paragea* and *boreopacifica* is therefore fortuitous and in my opinion does not indicate very close relationship.

The gastropore in *paragea*, while somewhat variable in depth, is at least twice as deep as the length of the gastrostyle, and usually even

deeper, measured to the rim of the gastrostome as shown in the drawing (pl. 41, fig. 1*b*). Dr. Broch's drawing of the type of *boreopacifica* (1936, p. 57, fig. 17*b*) indicates a much shallower gastropore with a narrower mouth. His drawings of his Alaskan specimens (fig. 17*c*, *d*) indicate that the cyclosystem is broader than in the Asiatic type (fig. 17*a*). A good character of *paragea* is the slight expansion of the bottom of the gastropore to form a style chamber (pl. 41, fig. 1*c*). There are usually small spicules on the ridge marking the transition between this chamber and the pore above. In specimens cleaned with sodium hypochlorite (as for example the specimen from Alaska, Hans Jensen, listed by Dr. Broch and very kindly loaned for examination) these tiny spicules can be seen jutting from the wall, deep within the gastropore. No specialized style chamber is shown in Dr. Broch's drawings nor exists in the Okhotsk Sea form of *boreopacifica*. (See also Broch, 1932, fig. 2*d*.)

ALLOPORA CAMPYLECA TYLOTA, new subspecies

PLATE 41, FIGURES 2-2*e*

*Diagnosis*.—Differing from *A. campyleca* in the following particulars: More delicate structure of colony, presence of irregular spiculate outgrowths from the wall of gastrostyle chamber, differentiating the chamber from the portion above; a slender gastrostyle in female as well as in male colonies; generally radially shorter dactylotomes, with correspondingly wider gastrostome; more prominent female ampullae.

*Description*.—The material consists of four fragments of the main branches and eight of branchlets from one or more male colonies, and a fragment of a robust branch of a female colony. The complete colony may well have been as large as the type of *campyleca*, but was more open, with fewer anastomoses. The peripheral branches are more delicate, the lateral cyclosystems projecting two or three times their own diameter. There is a definite front and back, the latter without cyclosystems but with ampullae, except on largest branches. Length of largest fragment 95 mm; diameter of stem 14 mm.

The cyclosystems are scattered not thickly on front of the colony and form fairly regular series on the sides of the branchlets, frequently projecting conspicuously. The gastropore is deep, usually slightly curved, and the style is a little stouter than in the male of *campyleca*, there being no marked differences in the gastrostyles of male and female colonies. About midheight of the style irregular spicules project from the gastropore wall (pl. 41, fig. 2*a*). In some gastropores these spicules occur also below this point, on the walls of the thus differentiated style chamber (pl. 41, fig. 2*e*). Length of the finely spiculate style about 0.5 mm. There are usually about 12 to 17 dactylotomes, rather shorter than in typical *campyleca*, but as deeply

cut on side of gastropore, such cyclosystems measuring about 1 to 1.25 mm in diameter. There are smaller ones, with 10 to 12 pores, on the smallest branches; and in the female specimen there are numerous large ones (1.5 mm in diameter) with upward of 20 dactylotomes (pl. 41, fig. 2). Owing to small dactylopores and narrow dactylotomes the styles are extremely small, although the spicules extend above the mouth of the pore proper in many of the systems.

The male ampullae are very similar to those of *campyleca*, but the roof is a shade thicker. The female ampullae are even more prominent than in *campyleca*, usually projecting more than a true hemisphere, and have slightly thicker, spongier walls. The interior surface is usually deeply fenestrated, forming a coarse, spongy reticulum with irregular projections into the lumen, which is in some cases partly or even entirely occluded. Other ampullae have a fairly firm inner surface, which is simply irregularly pitted. The summit of some of the ampullae is very slightly irregular with incipient folds or knobs; others are perfectly smooth.

The coenosteum is similar to that of *campyleca*. In properly cleaned material the microscopic pores are even more evident.

Color pale buff, becoming pure white after cleaning with sodium hypochlorite.

*Type*.—U.S.N.M. no. 43263.

*Type locality*.—Station 4781, off Agattu Island, Aleutian Islands, lat. 52°14'30" N., long. 174°13' E., 482 fathoms, fine gray sand, pebbles; bottom temperature 38.6° F.

*Remarks*.—This form has been interpreted as a deeper water race of *A. campyleca*.

**ALLOPORA CAMPYLECA TRACHYSTOMA, new subspecies**

PLATE 45, FIGURE 2; PLATE 46; PLATE 54, FIGURES 1-1b

*Diagnosis*.—Colony ornate with massive irregular stems and often flattened branchlets which do not anastomose freely; coenosteum buffy pink, minutely roughened; cyclosystems with upward of 18 long, narrow, deep dactylotomes separated by rough coarsely porous septa, which *encroach upon the narrow gastrotome* and are continued, as decurrent ridges, on the walls of gastropore; the latter deep, slightly curved, and with a differentiated style chamber, the upper border of which is sparsely armed with spicules; style medium slender. Largest fragment 165 mm by 80 mm; main stem 30 mm in diameter.

*Description*.—The color is buffy pink, becoming a decided pale pink after cleaning with sodium hypochlorite. The colony is dendritic but compressed into an irregular flabellate form, the distal branches

often delicate and subdividing freely. There is a definite front and back, the protuberant cyclosystems being rather widely spaced on former, very few on latter. They are more numerous on the lateral faces of the branches, but when these are not compressed the cups are scattered on all surfaces. The smallest cyclosystems near end of branchlets have 9 or 10 dactylotomes; the full-sized systems, 12 to 18. The most trenchant characteristics of the cyclosystem are the deep and narrow dactylotomes and the spongy radial septa, which extend over the gastrostome and continue downward toward the style chamber as ridges on the wall of gastropore. As a result the gastrostome is conspicuously narrower than the pore below the level of the dactylotomes, as may be seen in a section view (pl. 54, fig. 1). The dactylotomes are deep, the slit descending conspicuously upon the wall of the gastropore. Diameter of full-sized cyclosystem 1 to 1.4 mm; depth of gastropore 2 to 3 mm; gastrostyle, 0.5 mm.

The peripheral branchlets are more or less flattened and on their sides the cyclosystems are usually asymmetrical, the distal dactylotomes being longer than the proximal (pl. 54, fig. 1b). There are also short flattened spinous outgrowths, especially on the lateral margin, or ambitus, of the branches, entirely independent of cyclosystems or ampullae (pl. 46, fig. 2). Cyclosystems are very scarce on the back of the colony. In several places branches have been broken off and new ones have grown from the truncated end.

Male ampullae small, as in *campyleca*, rather closely and irregularly scattered on the front and back of branches; their convex dorsal wall about half as thick as the diameter of the subspherical interior (which is 0.32 to 0.42 mm). Female ampullae resemble those of *campyleca* in form, but the surface is minutely roughened, or provided with small tubercles, or on peripheral parts of colony may be traversed by low, narrow, interrupted ridges (pl. 54, fig. 1a) giving a rugose appearance. The inner surface is pitted but is not particularly spongy or spiculate.

Coenosteum very hard; the surface not shiny but minutely roughened and porous; the texture accentuated on the septa of the cyclosystems and on surface of ampullae. The tiny vermiculations or interrupted irregular ridges to which the surface texture is due are beset with microscopic spicules similar to those of *brochi*.

*Type*.—U.S.N.M. no. 43265.

*Type locality*.—Station 4784, off East Cape, Attu Island, Aleutian Islands, lat. 52° 55' 40'' N., long. 173° 26' E., 135 fathoms, coarse pebbles.

*Specimens examined*.—Parts of two female colonies and of two male colonies.



## ALLOPORA MOSELEYANA, new species

PLATE 49, FIGURE 2; PLATE 50; PLATE 51; PLATE 53, FIGURES 1-1b

*Diagnosis.*—Colony large, flabelliform, concavo-convex, grayish white with strongly differentiated stems and branches, both often anastomosing in mature colonies; cyclosystems prominent, with 7 to 12, generally 9 or 10, dactylopores and a fairly deep, usually straight gastropore; gastrostyle robust, pointed; cyclosystems very scarce on posterior face of colony; surface of coenosteum very compact, hard, lustrous.

*Description.*—Colony large, flabelliform, concavo-convex, with massive main branches, some of which anastomosing; branchlets very irregular, flattened, and springing from sides of the principal stems; only a few from concave front of colony and occasionally a short abortive twig from the back. Length of type (only a part of a larger colony) 190 mm; width 160 mm.

The cyclosystems are normally protuberant from one-fourth to about their own diameter. On the lateral face of branchlets, which are close to other branchlets, the cyclosystems are usually flush with the surface, a very neat adaptation to the necessities of their situation. Dactylotomes 7 to 12, usually 9 or 10, with subparallel sides, the radial dimension commonly about one-fourth total diameter of system. The spiculate dactylostyle extends slightly above mouth of pore as seen from side of gastropore. Gastropore rather deep, with a well-defined ventral chamber, the upper margin of which is spiculate and surrounds the style at about midheight. Depth of gastropore two and one-half to three times length of style. Gastrostyle robust, spiculate, 0.45 to 0.6 mm in length and 0.25 to 0.3 mm in diameter. As viewed from above the style occupies a conspicuous portion of the width of the gastropore, especially in those cyclosystems on the exposed front of the colony. The style shown in plate 53, figure 1, is of minimum width. Diameter of cyclosystem 0.85 to 0.9 mm; depth 1.2 to 1.7 mm.

Male ampullae superficial, numerous on back of the branchlets (but not main branches) and also on front (pl. 51; pl. 53, figs. 1 and 1b, a). They form circular, abruptly convex swellings (a little less than the diameter of a cyclosystem), which are usually provided with an apical differentiated protuberance (often perforated) and sometimes carry also accessory, often smaller, protuberances evidently the same as those scattered on surface of coenosteum. Cavity of ampulla sub-spherical, its inner surface deeply fenestrated and with irregular thin protruding laminae and flattened chisel-shaped spicules. There appear to be a few deeper-lying ampullae. Female ampullae (pl. 49, fig. 2; pl. 50) larger, low hemispherical, with a smooth outer surface. Surface of cavity not so rough as in male.

The coenosteum, when cleaned, is hard, compact, smooth, lustrous, and without the microscopic pores of *Allopora campyleca*, although on the branchlets the surface shows irregular low, vermiculate, anastomosing ridges, rather pronounced near the cyclosystems. There are scattered, granuliform protuberances, especially on the smaller branches. Small pores about the size of a dactylopore, or smaller, are widely scattered between the cyclosystems (pl. 53, fig. 1, b, p).

Color of dried colony grayish white; when cleaned with sodium hypochlorite the coenosteum changes to pinkish white.

*Type*.—U.S.N.M. no. 42869.

*Type locality*.—Station 4781, Bering Sea near Agattu Island, lat.  $52^{\circ} 14' 30''$  N., long.  $174^{\circ} 13'$  E., 482 fathoms, fine gray sand and pebbles; bottom temperature  $38.6^{\circ}$  F.

*Specimens examined*.—The type in several fragments. Also from station 3480, 7 fragments (2 male, from 2 colonies; 5 female, from possibly as many different colonies).

*Remarks*.—Through the cooperation of Dr. Broch I have been able to compare the type of *moseleyana* with the cotype of *Allopora scabiosa* (Broch). The two species are probably rather closely related but perfectly distinct. In *scabiosa* the surface of the coenosteum, when carefully cleaned, is not glossy or so close-grained as in *moseleyana*, nor are the cyclosystems so protuberant. In *scabiosa* there is not a sharply differentiated style chamber at the bottom of the gastropore, nor are there spicules protuberant from the wall at about midheight of the gastrostyle as in both forma *moseleyana* and forma *leptostyla*. The style of *scabiosa* is much slenderer than in typical *moseleyana* but not slenderer than in forma *leptostyla* (which, however, has a well-developed style chamber, if anything more spiculate than that of forma *moseleyana*). The gastropore of *scabiosa* is usually slightly curved, and is more *funnel-shaped* than cylindrical.

In the specimens of *scabiosa* the female ampullae are convex to the same degree as in *moseleyana*. The male ampullae are also superficial and convex, but they seem never to carry the tubercle or tubercles which characterize those of *moseleyana*.

I have seen a colony of *Allopora norvegica* (Gunnerus) from Trondjhemsfjord, Norway, which has a lustrous, hard, whitish coenosteum like that of *moseleyana*. A young male colony of the latter species greatly resembles this Trondjhemsfjord example in form of colony and distribution of cyclosystems. But in *A. norvegica* there are 4 to 9, usually 5 to 7, dactylotomes, which cut much deeper into the side of the gastropore. The gastrostyle is broad, blunt, sometimes sub-hemispherical. The ampullae are imbedded in the branches and do not form conspicuous superficial convexities.

The architecture of the type of *moseleyana* resembles that of *Allopora profunda* Moseley from 600 fathoms off the mouth of Rio de

La Plata. In Moseley's species there are 12 to 16 dactylotomes, while the gastrostyle is much slenderer and shorter than in *moseleyana*. According to Moseley's figure (Moseley, 1879, pl. 39; also pl. 35, fig. 13) the style in length equals about one-fifth the depth of the gastropore. In *profunda* the ampullae are much smaller and "are usually entirely sunk beneath the surface, but sometimes near enough to it in situation to raise upon it very small conical elevations, which easily escape notice, and are present only here and there. The ampullae are present in abundance in the walls of the pore systems and at their bases."

This species is named in memory of H. N. Moseley.

ALLOPORA MOSELEYANA forma LEPTOSTYLA, new

PLATE 52

*Diagnosis*.—Differing from *A. moseleyana* in having a distinctly slenderer gastrostyle, which does not crowd the style chamber, and in having male ampullae, which form smaller superficial blisters.

*Description*.—There are two fragments of large branches, which indicate that this form grows to a considerable size. The type (pl. 52, fig. 2) is apparently a young colony.

The form of the cyclosystems does not differ materially from that of *moseleyana*. Dactylopores 7 to 12; dactylotomes radially as in *moseleyana*; gastrostome often slightly constricted. Gastropore averages a little shallower than in forma *moseleyana*. Style chamber well differentiated. The gastrostyle is about 0.5 mm long, slender, cylindrical-lanceolate in lateral profile. Diameter of cyclosystems 0.75 to 0.95 mm; depth of gastropore 1 to 1.2 mm. On each of two truncated branch-ends caused by fracture, two cyclosystems have regenerated.

Male ampullae (pl. 52, fig. 1) small, forming low conical protuberances, the width of which is less than that of cavity of ampulla (0.5 mm). Interior wall as in *moseleyana*. Female ampullae like those of *moseleyana* (pl. 52, fig. 3).

Color of dried colony very pale buff, bleaching to white in sodium hypochlorite solution.

*Type*.—U.S.N.M. no. 43270.

*Type locality*.—Station 3480, Amukta Pass, Aleutian Islands, lat. 52° 06' N., long. 171° 45' W., 283 fathoms, black sand, rocky.

*Specimens examined*.—From type locality: Type and parts of 2 other male colonies; 4 fragments of at least 2 female colonies.

*Remarks*.—This form appears to be a variant of *moseleyana*, as indicated. When the extraordinary number of species and subspecies dredged at station 3480 is taken into consideration, the question of hybridism is sure to arise; but there is absolutely no information upon which to base an answer.

## ALLOPORA SCABIOSA (Broch)

PLATE 76, FIGURES 7, 8

*Stylaster scabiosa* BROCH, Einige Stylasteriden (Hydrokorallen) der ochotskischen und japanischen See, p. 60, 1935.

*Stylaster (Allopora) scabiosa* BROCH, Untersuchungen an Stylasteriden, p. 72, fig. 24, pl. 12, figs. 32, 33, 1936.

*Diagnosis*.—Color red to pale warm pink; colony slenderly built, branching mostly in one plane; cyclosystems on all sides of peripheral branchlets; back of principal branches and stem almost without cyclosystems. Dactylotomes 7 to 15, mostly 8 to 11, cutting rather deep on side of gastropore, the sides parallel as viewed from above; gastropore about as deep as in *moseleyana*, but often slightly curved, more funnel shaped, with a less definitely differentiated style chamber; style slender.

*Type locality*.—Okhotsk Sea, lat. 54° 53' N., long. 144° E., 505 meters, bottom temperature 1.44° C.

*Specimens examined*.—Three fragments (cotypes).

*Remarks*.—In general habit this species is superficially like *S. norvegicus pacificus* but differs in having a more open funnel-shaped gastropore, smaller gastrostyle, more numerous dactylopores, and superficial ampullae. In the three fragments of the cotype sent me by Dr. Broch, the ampullae are in two distinct sizes. The larger, which I would call female, are low-convex, much lower than broad, and of about the diameter of a cyclosystem. They are very numerous on a dichotomously branched twig 20 by 30 mm. Two other branchlets have what I should call "male" ampullae, only half the size of the "female." These are nearly as prominent as in *A. moseleyana* and are similar in character to ampullae called "male" in other species, e. g., *S. cancellatus*, *A. polyorchis*.

Dr. Broch describes, however, only male gonophores. Whether these came from both sorts of ampullae or only the larger ones is not clear. Perhaps the use of the term male and female is ill-advised for material that is, oftener than not, dried. In *Cryptohelia* the larger ampullae are known to hold planulae. The small ampullae, called male, are not immature stages of the large ones, called female, since they frequently differ in form. They sometimes, as in *moseleyana*, are perforated as if for escape of sperm.

For a full description of *A. scabiosa*, Dr. Broch's paper should be consulted. He sums up the systematic position of *scabiosa* as follows:

"*Stylaster scabiosa* exhibits great similarity to a lightly built *Stylaster norvegicus* and in certain respects occupies an intermediate position between the latter and *S. boreopacificus*, but differs from both in having a much higher dactylopore count."

## ALLOPORA SOLIDA (Broch)

## PLATE 76, FIGURES 1, 2

*Stylaster solidus* Broch, Einige Stylasteriden (Hydrokorallen) der ochotskischen und japanischen See, p. 60, 1935.

*Stylaster (Allopora) solidus* Broch, Untersuchungen an Stylasteriden, p. 68, fig. 22, pl. 9, fig. 30, 1936.

*Diagnosis.*—Branches coarse, subterete, with slightly raised, well-spaced cyclosystems on all sides; no differentiated front and back; cyclosystems with 4 to 9, mostly 5 to 7, narrow dactylotomes, very shallow at gastropore end; gastropore very narrow, cylindrical, sometimes slightly curved, but usually oriented perpendicular to surface; Gastrostyle large, but only medium stout, and tapered regularly from base to a sharp point, its length half to two-thirds depth of gastropore; no differentiated style chamber; ampullae only slightly convex, not rugose.

*Description.*—The cyclosystems are very characteristic in having narrow dactylotomes, with parallel sides, as long as width of gastrostome and shallowly cut at inner end. The angular septa between the dactylotomes may slightly overhang the gastropore as in *stejnegeri* and *brochi*. The dactylopore proper is large and provided with a conspicuous style. When the cyclosystem is viewed directly from above, the wall separating dactylopores from gastropore appears as a definite ring (the top of which causes the shallow inner end of dactylotome). The surface of gastropore is pitted and roughened by irregular longitudinal ridges, but these are not decurrent from the septa as in *brochi*. The gastrostyle is long-conical, rather slender, not at all constricted at base, and ends in a sharp point. Diameter of cyclosystem 0.9 to 1.15 mm. Depth of a sample gastropore 0.95 mm; length of gastrostyle 0.6 mm, breadth at bottom 0.28 mm. The gastrozooids are without tentacles (Broch).

The female ampullae cause only a slight swelling of the surface, as in *A. verrilli*. This "roof" is 0.25 mm thick, the cavity 0.85 mm wide by 0.5 mm high; its surface is rough with many delicate spicules.

The coenosteum is hard with the characteristic finely vermiculate etching of the surface.

Color: Bright salmon pink to rose.

*Type locality.*—Okhotsk Sea, lat. 56° 24' N., long. 143° 18.5' E., 100 meters; temperature in 95 meters, 1.34° C.

*Specimen examined.*—A fragment of the type material, marked cotype, loaned by Dr. Broch.

*Remarks.*—Apropos of the absence of gastrozooid tentacles in this species, certain gastrozooids of *A. porphyra* lack tentacles apparently as a normal though infrequent variation.

*A. brochi* and *A. stejnegeri*, which have narrow cylindrical gastropores, differ from *A. solida* in the different type of colony, the noticeably convex ampullae. *A. stejnegeri* has rugose ampullae and a much smaller gastrostyle. *A. brochi* has deep-cut dactylotomes with decurrent ridges on sides of gastropore, a deeper, curved gastropore, and relatively smaller gastrostyle.

*A. solida* differs from *A. verrilli* in its narrower gastropore, that of *verrilli* being wider at mouth than the length of dactylotomes, and funnel shaped, not cylindrical. Its dactylotomes are characteristically constricted between dactylopore and gastropore as in *A. californica*.

ALLOPORA BROCHI, new species

PLATE 42, FIGURES 3-3d; PLATE 44; PLATE 45, FIGURE 1

*Diagnosis*.—Colony buff pink, small, with robust blunt branches produced in all directions, and without a definite front and back; cyclosystems well spaced, protuberant, distributed on all surfaces; differing from *A. solida* in the projecting cyclosystems, deeper gastropore, deeper dactylotomes, and more conspicuous, low-convex ampullae.

*Description*.—The form of the colonies is typical of a heavily built *Allopora* as the protuberant cyclosystems are about evenly distributed on all sides of the thick branchlets, which are somewhat flattened or compressed, with truncate and rounded ends. Type, 80 mm high; 50 mm greatest width.

The cyclosystems resemble those of *trachystoma* but are smaller, and the septa do not encroach so much upon the gastrostome. The dactylotomes, commonly 7 to 10 in number, are narrow and deep, and the dactylopore is rather occluded, as indicated in plate 42, figure 3. The gastropore is deep, narrow, curved as a rule, and of nearly uniform width (pl. 42, fig. 3b). As in *trachystoma* the septa are continued as low ridges far down the side of the pore, which is smooth, except for a variable number of small, scattered spicules at the lower end. This style chamber is not sharply differentiated from the part above. The gastrostyle is medium slender, but sometimes a short conical one is found as if it might be regenerating, although no injury to the pore is apparent (pl. 42, fig. 3d). The gastrostyle, surrounded by narrow, interrupted lacunae, may be traced into the coenosteum for a distance equal to its own length. Diameter of cyclosystems 0.68 mm to 1.2 mm; depth of gastropore 1.8 mm to 2 mm; style, 0.5 to 0.6 mm.

The female ampullae are evenly low-convex, with a granulated surface (pl. 42, figs. 3a and 3b). The dorsal wall is rather thick, and the inner surface is pitted and fenestrated but not spiculate. The

ampullae are unevenly distributed on all surfaces; not crowded. Diameter of ampullar chamber 0.6 mm to 0.9 mm. Male unknown.

The surface of the coenosteum is minutely porous and has a granulated appearance due to tiny vermiculations or interrupted irregular ridges, the surface of which is closely beset with microscopic crystal-like spicules, similar to those of *trachystoma*. There are rather numerous scattered, tiny dactylopores.

Color buff pink, becoming pale pink after cleaning with sodium hypochlorite.

*Type*.—U.S.N.M. no. 43264.

*Type locality*.—Station 4777, Petrel Bank, Bering Sea, lat. 52° 11' N., long. 179° 49' E., 52 to 43 fathoms, fine gravel; 2 specimens.

*Remarks*.—*A. brochi* is not especially like *solida* except in having a narrow gastropore and constricted gastrostome. This feature is found also in *trachystoma* which is believed to be nearly related to *A. campyleca*. If the position of the ampullae is really significant, *A. brochi* is quite definitely unlike *solida*. The growth habit of the two species is different, *solida* having coarse, subterete, anastomosing branches composing probably a very massive colony.

This species is named in honor of Dr. Hjalmar Broch, of Oslo, Norway.

ALLOPORA STEJNEGERI, new species

PLATE 42, FIGURES 2-2b; PLATE 56

*Diagnosis*.—Colony lobed, rather than branched; cyclosystems not protuberant, fairly evenly spaced on all surfaces, with usually 6 to 8 narrow, clean-cut dactylotomes, a narrow, cylindrical moderately deep gastropore, and relatively small gastrostyle; ampullae low-convex, ridged or rugose superficially. Differing from *A. solida* in the more prominent ampullae, deeper dactylotomes, and relatively smaller gastrostyle, as well as in the form of colony and its rougher surface.

*Description*.—Type colony with short, thick, irregular branches (pl. 56, fig. 2); greatest width 70 mm; height 40 to 60 mm, according to angle of measurement.

The cyclosystems have long, narrow, sharply cut dactylotomes, 5 to 12, ordinarily 6 to 8, in number, the width being uniform, not constricted adjacent to gastropore as in *verilli*. The dactylostyles are so small as to be rudimentary, whereas in *verilli* they are well developed. The dactylotomes are shallower than in *verilli*, where they cut deep on the sides of gastropore. The gastropore is usually slightly curved on the distal parts of the colony. Gastrostyle rather small, loosely put together (pl. 42, fig. 2b); no well-differentiated style chamber. Diameter of large cyclosystem 12 mm; depth of gastropore 1.5 mm.

Female ampullae (pl. 42, fig. 2*a*; pl. 56, fig. 1): The convex surface is thrown into rather sharp uneven ridges, or into irregular short tubercles, or both. Sometimes the ridges radiate irregularly from summit of convexity. Here and there are abruptly smaller ampullae, which may be seen in the photograph (also pl. 42, fig. 2*b*). It cannot be determined in the dry specimen, whether these are male ampullae or undeveloped female. Male colony unknown.

Coenosteum close-grained, hard, smooth on the main limbs, but on the branches roughened by low ridges and protuberances similar to those of ampullae (pl. 56, fig. 1).

Color, pale warm pink (light grenadine pink or orange-pink of Ridgway's nomenclature).

*Type*.—U.S.N.M. no. 43271.

*Type locality*.—Station 4777, Petrel Bank, Bering Sea, lat. 52° 11' N., long. 179° 49' E., 52–43 fathoms, fine gravel.

*Specimens examined*.—The type.

*Remarks*.—*Allopora stejnegeri* differs from all other species of red, pink, or purplish *Allopora* in the character of the ampullar wall, which is rugose, or ridged. The dactylotomes have clean-cut, sharp edges and are of uniform width. The gastropore is narrow, fairly deep, cylindrical.

This sharply differentiated *Allopora* is named in honor of Dr. Leonhard Stejneger, of the United States National Museum, dean of American taxonomers.

#### ALLOPORA BOREOPACIFICA (Broch)

PLATE 53, FIGURES 3–8*b*; PLATE 55, FIGURE 2; PLATE 76, FIGURES 9–11

*Stylaster (Allopora) boreopacificus* BROCH, Explor. des Mers d'URSS, fasc. 17 (1933), Inst. Hydrologique Leningrad, pp. 82, 84, figs. 1, 2, 1932; Einige Stylasteriden (Hydrokorallen) der ochotskischen und japanischen See, p. 60, 1935.

*Stylaster (Allopora) boreopacificus forma typica* BROCH (in part), Untersuchungen an Stylasteriden, p. 56, text fig. 17*a*, *b*, 1936; figs. 17*c*, *d*, and pls. 8–10 (figs. 24, 25 refer to *A. campyleca paragea*).

*Diagnosis*.—Cyclosystems small, with usually 5 and 6 (Okhotsk Sea), or 7 and 8 (Gulf of Tartary), narrow dactylotomes about as long as width of gastrostome; gastropore rather narrow, sometimes slightly curved, 0.8 to 0.9 mm deep, cylindrical, without a style chamber; gastrostyle slender, sharp, half as long as depth of gastropore; ampullae (female) conspicuous, slightly convex superficially, about twice as broad as cyclosystem; coenosteum minutely perforated, pink.

*Description*.—The material does not conform absolutely to the type specimen from St. Olga Bay, on the Asiatic coast at mouth of Gulf of Tartary, but the deviations are no greater than may be expected. Dr. Broch's material from the type locality was limited to a small fragment of the original specimen, a sketch of which appears



in Broch, 1932 (fig. 1). This shows a colony 120 mm high, somewhat flabellate in form, with heavy trunk and main branches, and numerous branchlets, some of which are in one general plane while others are in different planes. The *Albatross* material (1906) consists of small clusters of branchlets and twig ends evidently broken from a large colony (pl. 55, fig. 2).

Cyclosystems of branchlets very small, and frequently asymmetrical or incomplete, as shown in plate 53, figure 3a. These may have the lower rim of cyclosystem slightly raised while upper margin, with incomplete or suppressed dactylopores, is flush with general surface. Symmetrical systems have the rims raised about as much as in *pacifica*. Dactylotomes 1 to 9, most commonly 5 and 6, proportionately about as deep as in *pacifica* but distinctly narrow, while the whole cyclosystem is smaller. Plate 53, figure 2, represents an average cyclosystem of *pacifica* (0.8 mm). Dr. Broch records cyclosystem diameter of *pacifica* as high as 1.3 mm. Dactylostyle very poorly developed, much less so than in *pacifica*. Gastropore narrow, rather deep, sometimes slightly curved, or its axis oblique rather than at right angles to surface, of about the same shape as in *pacifica* and without a differentiated style chamber at the bottom. The pore is thus nearly cylindrical and does not widen conspicuously at gastrostome. Style slender, its length about half depth of gastropore; the latter is slightly deeper than in the type. The styles vary somewhat but are never robust as in typical *pacifica*. Diameter of cyclosystem 0.5 to 0.75 mm; depth of gastropore 0.9 mm; length of gastrostyle 0.4 to 0.5 mm.

In a male specimen certain of the cyclosystems have only 1, 2, or 3 dactylotomes.

Ampullae (female) low-convex, nearly or quite twice as broad as adjacent cyclosystems, among which they may be as thickly placed as the space will permit. The surface is smooth. Diameter outside 1.0 to 1.2 mm; of cavity 0.9 to 1.0 mm; height of cavity 0.6 mm; convex roof 0.15 to 0.25 mm thick.

In contrast to *pacifica* the surface of coenosteum is not lustrous and is microscopically perforated, the perforations in the form of interrupted, very irregular, often branched slits narrower than the intervening trabeculae.

Color of dried colony: Pale pink; bright rose (Broch).

*Type locality*.—St. Olga Bay, northeast of Vladivostok, mouth of Gulf of Tartary, 100 meters, small stones.

*Specimens examined*.—Okhotsk Sea (stations 5016 and 5017) numerous fragments. The bottom temperature of 29.8° F. is noteworthy. Twenty-three stations in the southern part of Okhotsk Sea made by the *Albatross* (1906) in 52 to 192 fathoms gave bottom readings of 29.8° to 32.1° F.

*Remarks.*—In the type of *boreopacifica*, dactylopores of 50 cyclo-systems ranged as follows: 5 had 6 dactylopores; 17 had 7; 15 had 8; 8 had 9; 4 had 10; 1 had 11. Seven and 8 therefore occur most frequently, whereas in the Okhotsk Sea specimens 5 and 6 are more frequent than 7 and 8, and 3 and 4 occur on the smaller branchlets. As the higher counts are found on the proximal parts of the fragments, it is likely that a complete colony would show a higher percentage of 7 and 8.

This species has the smallest cyclo-systems of any of the north Pacific *Alloporas*.

ALLOPORA VERRILLI Dall

PLATE 54, FIGURE 3; PLATE 57; PLATE 76, FIGURES 5, 6

*Allopora verrilli* DALL, Proc. Biol. Soc. Washington, vol. 2, p. 111, 1884.—FISHER, Ann. Mag. Nat. Hist., ser. 10, vol. 8, p. 391, 1931.

*Allopora moseleyi* DALL, Proc. Biol. Soc. Washington, vol. 2, p. 113, 1884.

*Stylaster (Allopora) norvegicus* forma *pacifica* BROCH (Strait of Georgia record), Untersuchungen an Stylasteriden, p. 52, 1936.

*Diagnosis.*—Colony small, forming lumpy incrustations, broad-lobed subflabellate upright masses, or little trees with robust to slender branches (pl. 57, figs. 1–3). Cyclo-systems medium-sized, with 4 to 11 fairly long, deep, subequal dactylotomes, constricted adjacent to gastropore, the sides of which slope inward toward the robust, pointed style, which fills the bottom; gastropore not deep; dactylostyles well developed. Male and female ampullae forming only slight convexities of surface of coenosteum.

*Description.*—The cyclo-systems (1 to 1.25 mm in diameter) usually have 6 or 7 (5 to 11) dactylotomes characteristically broader at the outer end. The finely spiculate dactylostyle is conspicuous, differing therein from *A. steynegeri* and agreeing with *A. californica*. In some cyclo-systems the dactylotomes may be larger on one side (as in *californica*) but this is not characteristic of the species. The gastropore is also much like that of *californica* in that it is narrowly funnel-shaped and is completely filled at bottom by the pointed style (pl. 54, fig. 3). The surface of gastropore is very rough, with tiny blunt protuberances.

The female ampullae are sunken in the coenosteum, the roof forming only a slight superficial convexity. The chamber is subspherical, about 0.75 mm in diameter. Its inner surface is rough but not intricately fenestrated or spiculate like the interior of gastropore.

Some of but not all the male ampullae form slight superficial convexities. The chamber is subspherical, 0.25 to 0.5 mm in diameter.

When thoroughly cleaned with sodium hypochlorite the surface of coenosteum presents a somewhat "sugary" appearance, more compact at base of colony than at ends of branches. The surface is fairly smooth, marked by fine vermiculations and perforated by microscopic

pores. There is no sign of the numerous surface papillae characteristic of *californica*, *papillosa*, and *porphyra*.

Color, dried, pale warm pink (orange-pink of Ridgway's nomenclature, becoming shrimp pink or safrano pink after treatment with sodium hypochlorite).

*Type*.—U.S.N.M. no. 4193.

*Type locality*.—Chika Islands, Akutan Pass, Aleutian Islands (near Unalaska).

*Specimens examined*.—The types, 5 specimens that had been thrown on beach. All are incrustations, chiefly on *Mytilus* shells and are more or less beach-worn. The best specimen is figured (pl. 57, fig. 3). Also from station 4777, 2 specimens (one on small stone, the other on fine cemented gravel).

Sucia Islands (vicinity of San Juan Islands), Wash., depth not recorded; 14 small colonies, all on large water-worn pebbles (pl. 57, fig. 1).

#### ALLOPORA NORVEGICA PACIFICA (Broch)

PLATE 53, FIGURES 2-2b; PLATE 55, FIGURE 1; PLATE 76, FIGURES 3, 4

*Stylaster (Allopora) norvegicus* BROCH, Einige Stylasteriden (Hydrokorallen) der ochotskischen und japanischen See, p. 59, fig. 2, 1935.

*Stylaster (Allopora) norvegicus* forma *pacifica* BROCH, Untersuchungen an Stylasteriden, p. 52, fig. 15, pl. 6, figs. 18, 19, 1936.

*Diagnosis*.—Colonies salmon pink, rose, or white, branching more or less dichotomously mostly in one plane; branches subterete, the medium-sized cyclosystems rather uniformly spaced on front of colony, scarce on back except at tips of branches; ampullae not forming superficial convexities except sometimes very slight ones near ends of branches. Resembling *A. verrilli*, but with narrower, deeper, cylindrical gastropores and less superficial ampullae.

*Description*.—The colony form is flabellate with robust branches of rather uniform thickness. The front of a characteristic fragment is shown by plate 55, figure 1. The back of the principal branches is usually nearly free from cyclosystems, but these appear at the ends of the branchlets.

The margin of the cyclosystems is slightly to decidedly raised above the level of coenosteum. In the *Albatross* specimens there are 3 to 9 dactylopores, usually 5 or 6. But in a count of 50 cyclosystems on each of 4 colonies, Dr. Broch found 7 in 65 instances, 6 in 5, 8 in 42, 9 in 18, 5 in 15. His colony no. 4, having a maximum of 8 dactylopores, corresponds more nearly with my material. The dactylo-  
tomes are deep cut extending ventrally about one-third depth of gastropore. In my specimens the radial dimension is much less than in Dr. Broch's, being about half width of gastrostome, while in the type material the length equals or slightly exceeds gastrostome width. In the type material the dactylo-  
tomes are rather narrow with sub-parallel sides as in *brochi*; in my specimens there is considerable varia-

tion, as they may be slightly expanded at the outer or dactylopore end, as in *verrilli* (pl. 53, fig. 2). Dactylostyle fairly conspicuous and extending well above mouth of slit as seen from inside of gastropore (pl. 53, fig. 2*b*). The gastropore is cylindrical or slightly constricted at about midheight of style. It is not so wide at gastrostome as in *A. verrilli*; hence is not at all funnel shaped but may be even a trifle narrower at mouth than midway to bottom. The style chamber exists only as a slight expansion at bottom and is not differentiated from the part above by special spicules. Ordinarily the gastrostyle is robust about twice as high as broad, broadly lanceolate in profile with an acute tapered end; length 0.5 to 0.6 mm in largest cyclo-systems. Owing to the oblique direction of gastropore into coenosteam or to its occasional slight curvature the style may be invisible when colony is held horizontally.

Diameter of cyclo-system of type material 0.8 to 1.3 mm (Broch). In the *Albatross* specimens the diameter of the largest cyclo-systems with 7 or 8 dactylopores is 0.8 to 0.85 mm; depth of larger gastropores 1.2 mm.

Puzzling variation is furnished also by four small fragments in which the cyclo-system structure is closely similar to that of other specimens, but the gastrostyle is much slenderer (pl. 53, fig. 2*a*). These specimens have been compared with the cotype of *A. solida* and are definitely not that species. The very shallow dactylotomes of *solida* are characteristic. In two sectioned cyclo-systems of one of Dr. Broch's white colonies I find gastrostyles slenderer than fig. 2*b*, and therefore *much slenderer* than Dr. Broch's figs. 15*b*, *c* (1936, p. 53).

There are rather numerous instances of one or two dactylopores forming part of a cyclo-system but without a dactylotome connection to gastropore (Broch, 1936, p. 53, fig. 15*d*).

The ampullae are sunk beneath the surface and are of 2 sizes. The smaller (pl. 53, fig. 2*b*) have a subspherical cavity, 0.4 to 0.5 mm in diameter, while the larger are 0.65 to 0.85 mm broad and 0.4 to 0.5 mm high. In these I found one or two structures (desiccated for over 30 years) which may represent planulae. On softening, clear spots resembling nematocysts were plainly visible.

Coenosteam hard, rather lustrous, minutely reticulated and roughened, the reticulations representing hollows or fine grooves separating microscopic irregular ridges which reflect light. On the rim of the cyclo-systems the texture is a little coarser and the coenosteam irregularly perforated or fenestrated, while the wall of gastropore is perforated and roughened by irregular convexities.

Color of dried colony, pale warm pink to salmon red (grenadine pink to dull flame scarlet of Ridgway's nomenclature). Dr. Broch records two white colonies, one of which I have seen.

*Type locality*.—Okhotsk Sea, lat. 56°10' N., long. 143°15' E., 182 meters, bottom temperature 0.51° C.

*Specimens examined*.—Okhotsk Sea (stations 5016 and 5017), numerous fragments; two of Dr. Broch's types.

*Remarks*.—It is noteworthy that the bottom temperature at station 5016 was 29.8° F., therefore lower than at the type locality.

Dr. Broch examined one of my specimens from station 5016 and identified it as *pacifica*. It is nevertheless rather different from his material. Added to this is the confusing matter of two gastrostyle sizes in my specimens. If these are all one species, it is certainly a variable one.

Dr. Broch writes me that the record of *pacifica* from 60 fathoms, Strait of Georgia, pertains to *A. verrilli*.

ALLOPOREA CALIFORNICA Verrill

PLATE 58; PLATE 61, FIGURES 3-3b

*Allopora californica* VERRILL, Proc. Essex Inst., vol. 5, no. 3, p. 37, 1866; Trans. Connecticut Acad. Arts and Sci., vol. 1, p. 516, pl. 10, fig. 8, 1868.—FISHER, Ann. Mag. Nat. Hist., ser. 10, vol. 8, p. 392, pl. 15, figs. 3-3b, 1931.

*Diagnosis*.—Cyclosystems flush, very numerous, with slightly raised margin and 4 to 8 (ordinarily 6 or 7) unequal, prominent dactylotomes slightly constricted adjacent to gastropore; gastropore narrowly funnel-shaped, moderately deep, the bottom occluded by prominent, ovoid, gastrostyle; ampullae close to surface but not forming raised blisters. Colony palmate arborescent without differentiated anterior and posterior faces.

*Description*.—The type colony is 140 mm high and 125 mm broad; a comparable one from Monterey Bay, Calif., is 270 mm broad by 180 mm high (pl. 58; U.S.N.M. no. 43275). Another colony from Monterey Bay, which is perhaps a record for size, measures 290 mm high, and 480 by 350 mm in area. Rather numerous, massive, irregular, coalesced trunks form the heavy base of the colony, from which spring roughly palmate elements subdivided (sometimes dichotomously, sometimes not) into irregular branches. There are fully 200 of the terminal blunt branchlets 5 to 8 mm in diameter. Some of the branches coalesce above the basal irregular mass of trunks. Another specimen (Monterey Bay) is 160 mm high, about 190 mm broad, and 60 to 80 mm thick. The base of the colony is solid, roughly fan-shaped, the short thick branches arising in several tiers from the margin and subdividing dichotomously.

The cyclosystems are very numerous, 0.6 to 1 mm in diameter, characteristically funnel- rather than cup-shaped, the margin indented by usually 4 to 8 *unequal* dactylotomes, which are broader at ends than next to the gastrostome. They incise the sides of gastropore deeply (pl. 58, fig. 3b). Margin of cyclosystem is raised slightly above the coenosteal surface as a low abrupt ridge. There is some variation in the size of dactylotomes, but their inequality is very

characteristic both of the type specimen and the Monterey Bay specimens. Occasionally two cyclosystems are merged into a larger irregular one with two gastrostyles. In *A. californica* the gastrostyle is really smaller and slenderer than in *A. venusta* but, when viewed from above, appears to be larger. A section of the cyclosystem shows that only a part of the gastrostyle of *venusta* can be seen from above, while in *californica* the entire width is exposed.

The ampullae lie just under the surface but do not form blisters. Male ampullae (as in type) are very numerous, subspherical, 0.25 to 0.4 mm in diameter, and packed between the cyclosystems in one layer, to such an extent that the dividing walls are very thin. The female ampullae are also very numerous, oblate spherical to ellipsoidal, and 0.7 to 1 mm in diameter (pl. 58, fig. 3b).

The coenosteum of the branches, when fractured, is rather porous, but the surface layer is firm and the surface itself has a minutely "sugary" texture. It is sometimes provided with low papilliform prominences, which may be so numerous as to be set apart only once or twice their own diameter all over the surface of the colony; or they may be nearly absent, only sparsely scattered on terminal twigs (largest colony, male); or practically absent (large colony, female). In addition there is a variable number of papilliform pores (pl. 58, fig. 3), raised orifices of canals descending into the coenosteum, often in the walls between ampullae. These are very numerous in a large female colony and are regarded as independent dactylopores.

Color variable: Coral red, light coral red, coral pink; jasper pink shading to acajou red and pompeian red, with tips of branches ochraceous-salmon paling to light ochraceous-salmon (largest colony). One branch of largest colony is dull pleroma violet (Ridgway's nomenclature):

*Type*.—Peabody Mus. (Yale Univ.) no. 447.

*Type locality*.—California.

*Specimens examined*.—The type, "California"; Monterey Bay, Calif., 4 colonies, one very large; Carmel Bay, Calif., 1 colony; station 3158, 12 small colonies and fragments; station 3159, fragments.

*Remarks*.—I have examined the type colony, of which a fragment was kindly donated for direct comparison with my material from Monterey Bay. Verrill states that the type was collected by Maj. William Rich during the war between Mexico and the United States and may have come from deep water in the Gulf of California. The Monterey Bay examples are typical and were taken in about 25 fathoms in some cases probably deeper since they were brought up on rock-cod lines.

The cyclosystems resemble those of *A. verrilli*, where, however, the dactylotomes are normally equal. In *verrilli* the ampullae form low blisters on the surface. *A. verrilli* has not been taken south of the

Sucia Islands, Wash., while *californica* has not been found north of the region of the Farallone Islands, Calif.

ALLOPORA VENUSTA Verrill

PLATE 55, FIGURE 3; PLATE 61, FIGURES 2, 2a

*Allopora venusta* VERRILL, TRANS. CONNECTICUT ACAD. ARTS AND SCI., vol. 1, p. 517, pl. 10, fig. 9, 1868.—FISHER, ANN. MAG. NAT. HIST., ser. 10, vol. 8, p. 393, pl. 15, figs. 2, 2a, 1931.

*Diagnosis*.—Differs from *A. californica* in having very short dactylotomes and a shallower gastropore with rounded bottom; gastrostyle larger, enclosed in a definite style chamber, its summit encroached upon by bottom of gastropore proper.

*Description*.—All the specimens of this species I have examined are much smaller than those of *californica*. The type colony is 25 mm high and 50 mm broad, its expanded base attached to a water-worn stone. It rises in stout lobes or branches; some of the branches are broad and somewhat palmate or digitate; the terminal branchlets are mostly round, about 3 or 4 mm thick, with obtusely rounded tips. Several small colonies all from Cape Flattery, Wash., are about 35 mm high and 40 mm broad, with few dichotomous branches. The Monterey colony is 70 mm high, 70 mm broad, and about 30 mm thick.

The cyclosystems are subcircular, with a low, abruptly raised border, and 5 to 8, usually 6 or 7, shallow subequal, dactylotomes, much smaller and more nearly equal than those of *californica*. The central cup is shallower and of a different form (pl. 61, fig. 2a). These differences are not brought out by Verrill's diminutive figures. Viewed from above, the gastrostyle tip is seen through a subcircular aperture of the bottom of the cup. The border of this aperture is a ridge composed of ornate, lobate rugosities, somewhat more prominent than the fenestrated rugose skeleton of the cup itself and only clearly apparent in specimens cleaned with sodium hypochlorite solution. The entire breadth of the minutely hirsute style is not apparent from above. Diameter of cyclosystems 0.5 to 0.8 mm.

The ampullae are imbedded in the coenosteum and only occasionally produce a faint swelling of the surface. The male are subspherical or a little higher than broad and about 0.25 to 0.4 mm in diameter. The female are about 0.75 mm in diameter and conspicuously lower than wide.

A pale violet form from Cape Flattery, 40 fathoms, has usually appreciably deeper cups than the type forma. The marginal dactylopores are typical.

A southern form (Farallone Islands and Monterey Bay, rose pink in color) also has slightly deeper cups. The Monterey Bay example, in addition, has an unusually small aperture in the bottom of the cup,

so that the subacute end of the gastrostyle (which is somewhat slenderer than in the type form) is less exposed than in northern specimens.

In *venusta* the surface of the cleaned coenosteum is smooth, not minutely pitted or fenestrated, yet, owing to the underlying structure, under strong magnification it reminds one of pink sugar. The little papillae are sparse and of uncertain occurrence, and the intercalycine dactylopores are scarce, tiny, and without a raised border (which is not always present in *californica*).

Color: There are two color phases, the prevalent pink one (a dull begonia rose to alizarine pink) and a faded violet form (tourmaline to laelia pink) occurring off Cape Flattery.

*Type*.—In Museum of Comparative Zoology, Cambridge, Mass.

*Type locality*.—Neah Bay, near Cape Flattery, Wash.

*Specimens examined*.—The type. Also from Station 2873, 1 colony; station 2874, 24 small colonies and fragments; station 2875, 15 small colonies and fragments; station 2888, 3 colonies; station 3050, 1 colony; station 3158, 1 colony; Monterey Bay, Calif., 30 fathoms, 1 colony.

#### ALLOPORA PAPILLOSA Dall

PLATE 54, FIGURES 4, 4a; PLATE 59, FIGURE 3

*Allopora papillosa* DALL, Proc. Biol. Soc. Washington, vol. 2, p. 113, 1884.—FISHER, Ann. Mag. Nat. Hist., ser. 10, vol. 8, p. 391, 1931.

*Diagnosis*.—Colony small, thin, incrusting; cyclosystems asymmetrical, small, with funnel-shaped gastropore and 4 or 5 short, deep, unequal dactylotomes, asymmetrically distributed; a differentiated style chamber partly occluding the finely spiculate, pointed, large, subconical gastrostyle; dactylostyles well developed; coenosteum papillose, fenestrated, sugary in texture.

*Description*.—Owing to meagerness of material every statement concerning this species must be regarded as provisional. The entire type fragment shown in the photograph measures only 10 mm, longest dimension, and is a thin incrustation removed from a fragment of *Mytilus* shell.

The cyclosystems resemble those of *californica*, but the style is enclosed in a style chamber, the top of which, formed by outgrowths from side of gastropore, partly hides the large style, the entire width of which is not apparent when the gastropore is examined from above. In this feature the cyclosystem resembles that of *venusta*, but the gastropore is funnel-shaped, and the dactylotomes are longer, unequal, and asymmetrically arranged. The deep dactylotomes descend on side of gastropore more than halfway to tip of gastrostyle. Dactylostyles conspicuous. The largest cyclosystem (pl. 54, fig. 4) is 0.85 by 0.9 mm in diameter.



The coenosteum is scarcely thicker than depth of gastropore. Its surface is occupied by numerous, rather uniform, thimble-shaped papillae, a little broader than a dactylotome, rising about as high as the rim around cyclosystem. General surface spiculate or finely granulated. Under high magnification it appears very irregularly fenestrated and spongy, a characteristic also of the rim and interior walls of cyclosystems.

No ampullae can be detected.

Color "livid madder pink or brown" (Dall). The colony was badly in need of cleaning owing to dried organic material. After clearing with weak sodium hypochlorite the color changed to purplish vinaceous when wet; or pale laelia pink when dry (Ridgway's nomenclature).

*Type*.—U.S.N.M. no. 6852.

*Type locality*.—Coal Harbor, Unga, Shumagin Islands, Alaska.

*Specimen examined*.—The type.

*Remarks*.—The detailed figures of this species (pl. 54, figs. 4, 4a) have been placed next to those of *petrograpta* for convenience of comparison. Yet it seems to me that *papillosa* is possibly an offshoot of *californica* stock, while *petrograpta* is more likely related to *porphyra*.

#### ALLOPORA PORPHYRA (Fisher)

PLATE 59, FIGURES 1, 2; PLATE 60; PLATE 61, FIGURES 1, 1a; PLATE 70, FIGURES 2, 2a

*Stylantheca porphyra* FISHER, Ann. Mag. Nat. Hist., ser. 10, vol. 8, p. 395, pl. 16, figs. 5, 5a-5b; pl. 17, figs. 6, 6a-6c, 1931.

*Diagnosis*.—Colony encrusting, thin, reddish purple, with typically large circular or elliptical cyclosystems, having usually 8 to 12 subequal, short dactylotomes; gastropore relatively very wide and open with from 1 to 12 (ordinarily 3 to 7) robust gastrostyles, variable in size; coenosteum firm with numerous small, papilliform prominences, occasionally arranged in subparallel rows, or coalesced into interrupted meandering ridges.

*Description*.—The cyclosystems, which are subcircular to elliptical and relatively large, have a low, raised border indented by usually 8 to 10 dactylotomes, whose radial extent is equal to from one-fourth to one-third the diameter of the gastropore alone; rounded bottom of gastropore a little broader than the top. On the side of the cup the dactylotomes extend about 0.6 to 0.7 the distance to bottom. Diameter of cyclosystems 1 to 2 mm, usually 1.25 to 1.5 mm; depth about equal to extreme width. Occasionally two cups coalesce, but the ordinary elliptical cups are not formed by a union of two. The most characteristic feature of this species is the presence of 3 to 7 gastrostyles in both circular and elliptical cyclosystems, 3 or 4 being a common

number. In a colony from Carmel Bay the number runs higher, ranging from 5 to 12 (pl. 60). In the type colony cups with single gastrostyles are rather exceptional, but in another colony cups with one are slightly in the majority. The styles differ greatly in size, vary in form from subglobose to elongate acorn shape, and are beset with delicate, often pronged spicules. The interior of the cup is of a minutely fenestrated, spongy structure, which closely encircles the style, forming a style chamber almost filled by the style (pl. 59, fig. 1*a*). In some cases the entire breadth of style can not be seen from above on account of the encroachment of the roof of style chamber (or bottom of gastropore proper).

In aquaria the zooids expand rather readily. Their form and posture in the cyclosystem are best indicated by the figures (pl. 70, figs. 2, 2*a*). The gastrozooid has an elongate-ovoid form, the hypostome representing the broader end. The tentacles are small, blunt, 5 to 8, commonly 6, in number, and are inserted at about midheight. I have one small fragment with expanded gastrozooids on which I can find no definite tentacles. In many other fragments examined the zooids all have tentacles characteristically short with rounded tips. At the bottom of the gastrozooids the style is plainly visible whenever the mouth is widely expanded. When the gastrozooid retracts, it retires below the bottom of the cup to the slight space immediately surrounding the style—that is, into the style chamber.

The surface of the coenosteum is firm, sugary in texture under high magnification, and unevenly beset with small papillae somewhat less in diameter than a dactylopore. These papillae vary in spacing, and areas exist entirely free from them. They are sometimes merged into low ridges. In the Carmel Bay example these often form costae on the sides of certain cyclosystems rendered more prominent by the inequalities of the granite on which the colony grows (pl. 60).

The ampullae do not form rounded or blisterlike prominences, yet they may be closely packed between the cyclosystems, each cell about one-third to one-half the width of a cyclosystem. The male ampullae are subspherical, about 0.3 mm in diameter. The female ampullae are probably normally higher than broad (0.4 mm by 0.6–0.8 mm) and are sometimes so crowded that a sectional view reminds one of a miniature purple honeycomb.

*Type*.—U.S.N.M. no. 43018.

*Type locality*.—Pescadero Point, Carmel Bay, Calif. (lat. 36°33'30'' N.); on granite rock, in grotto exposed at lowest tides.

*Remarks*.—This species stands apart from all *Alloporas* and *Stylasters* by reason of the peculiar organization of the cyclosystem, which typically houses a small aggregation of gastrozooids, although excep-

tionally in less vigorous colonies cyclosystems with only one gastrozoid (and hence one gastrostyle) are found. Whether this condition is of generic or even subgeneric value only more knowledge of the *Stylasterina* will determine.

The number of tentacles of the gastrozoid varies from 5 to 8 and is commonly 6. Moseley (1879, p. 471, pls. 39, 40)<sup>3</sup> suggests that the presence of 12 tentacles on the gastrozoid may characterize *Allopora* and 8 *Stylaster*. But it has been shown (Hickson and England, 1905, p. 7) that the number of tentacles in *Stylaster* is variable, *S. filigranus* having 4, 5, 6, or 7.

This species has been found only at lowest tide on the exposed coast from Monterey Bay to a few miles south of Carmel Bay. The type colony, along with several others, lives in a small grottolike cavity, through which there is free circulation of water. Here they form lichenlike splashes of ruddy purple in contrast to white, scarlet, and yellow sponges, orange and bronze hydroids and bryozoans, and brown tunicates.

In 1919 the type colony alone lived in this grotto. Then it measured about 50 mm in diameter; now it measures 300 by 250 mm. From time to time sponges and tunicates that encroach upon it have been removed.

The real home of the species is probably in the dimly lighted region below lowest tide, as its occurrence in the intertidal zone is rather sporadic. Conditions at the type locality favor the upward migration of subtidal species.

ALLOPORA PETROGRAPTA, new species

PLATE 54, FIGURES 5, 5a; PLATE 59, FIGURE 4

*Diagnosis*.—Colony thin, encrusting; differing from *A. porphyra* in having smaller cyclosystems with normally only one gastrostyle; differing from *A. papillosa* in having a thicker gastrostyle, the rounded summit of which occupies the greater part of the breadth of gastropore when viewed from above; the gastropore less funnel-shaped and more tubular; surface of coenosteum with finer texture than in *papillosa*.

*Description*.—The material consists of five small fragments. Two of these, constituting the type, comprise the greater part of one colony (12 mm broad and 10 mm high), which covered a *Balanus*. An infant colony covers a barnacle only 6 mm broad. Colonies may reach a diameter of a foot or more, as observed by E. F. Ricketts.

The outline of cyclosystem resembles that of *papillosa* in its usual lack of symmetry, there being 3 to 8 short, deep dactylotomes with

<sup>3</sup> He says 6 tentacles for *Stylaster* but means 8, so stated on p. 477.

conspicuous dactylostyles. But the sides of the gastropore do not converge so much toward bottom as in *papillosa*, while the broader round-topped gastrostyle, as seen from above, is more than half as broad as the gastropore proper (i. e., cyclosystem less dactylotomes). In *papillosa* it is less than half. The gastrostyle shown in plate 54, figure 5a, is average; some gastrostyles are lower and broader, while a few approach more nearly the dimensions of plate 54, figure 4a (*papillosa*). These are rather the exception and occupy smaller gastropores, so that even here when seen from above the gastrostyle is more than half the breadth of gastropore.

A few male ampullae are visible on the fractured margin of type. They are imbedded in the coenosteum, and the walls are very rough from spicules. Two other fragments show female ampullae on the fractured margin. They are a little larger than the male and their height is a little greater than breadth (pl. 54, fig. 5a).

The surface of the coenosteum is appreciably finer textured than in *papillosa*, while the apparently characteristic papillae of that species are here fewer and lower—certainly of no importance as a positive character. A few dactylopores pierce the coenosteum but are not on papillae as in *californica*.

Color: The smallest colony is dull eosine pink, while the four larger fragments are dull manganese violet. E. F. Ricketts, who collected the specimens, states that larger colonies out of reach in the surf appeared to be distinctly red, rather than purple.

*Type*.—U.S.N.M. no. 43272.

*Type locality*.—Kyack Island, mouth of Sitka harbor, Alaska.

*Specimens examined*.—Five small fragments collected by E. F. Ricketts, of Monterey, Calif., August 5, 1932.

*Remarks*.—*A. petrograpta* forms reddish patches on hard rocks at lowest tide level where it is exposed to surf. Mr. Ricketts states that the habitat is the same as that of *A. porphyra*. While the colonies vary in size, the larger are of the order of a foot in diameter and may be partly exposed by receding tide. Specimens were very difficult to procure on account of surf and the rugged nature of the shore.

On the basis of available material, *A. petrograpta* is perfectly distinct from *A. papillosa*. The latter appears to be related to *A. californica*, while *petrograpta* is more like *A. porphyra*. *A. porphyra* differs radically in having much larger cyclosystems with characteristically multiple gastrostyles. But the form of the gastrostyle and the immersion of each in a tightly enclosing chamber is not fundamentally different from the structure of the single gastrostyle of *petrograpta*. Abnormally *petrograpta* may have two gastrostyles to a cyclosystem, while *porphyra* sometimes has only one.

## SUMMARY OF THE REDDISH, ROSE, AND VIOLET SPECIES OF ALLOPORA

- a*<sup>1</sup>. Ampullae forming definite convex blisters on the surface of colony.
- b*<sup>1</sup>. Ampullae with a ridged or corrugated surface (see also *polyorchis* and *trachystoma*); gastropore narrow, cylindrical; gastrostyle small; dactylotomes 5 to 12 with clean-cut parallel sides, as long as width of gastrostome.....*stejnegeri*
- b*<sup>2</sup>. Ampullae not wrinkled or ridged but sometimes male ampullae have low central tubercle, or several.
- c*<sup>1</sup>. Gastropore narrow, ordinarily cylindrical, deep, the mouth rather constricted, not obviously broader than length of dactylotomes.
- d*<sup>1</sup>. Cyclosystems larger, protuberant; septa encroaching upon gastropore and decurrent as ridges on its side; gastropore deep, curved (see also *campyleca* and *trachystoma*); cyclosystems not frequently incomplete.....*brochi*
- d*<sup>2</sup>. Cyclosystems very small, not protuberant; dactylotomes about as long as diameter of gastrostome, which is not encroached upon by angles of septa; cyclosystems often incomplete or with one or more isolated dactylopores...*boreopacifica*
- a*<sup>2</sup>. Gastrostome broader than length of dactylotome.
- d*<sup>1</sup>. Colony white or buff (see also *polyorchis*); gastropore subcylindrical with a definite style chamber and robust style; male ampullae with a central low tubercle, or several.....*moseleyana*
- d*<sup>2</sup>. Colony rose or yellowish rose; gastropore broadly funnel shaped, curved, with a narrow style chamber; ampullae without tubercle.....*scabiosa*
- a*<sup>2</sup>. Ampullae forming low inconspicuous convexities on surface (see also *scabiosa*).
- b*<sup>1</sup>. Gastropore subcylindrical, the gastrostome encroached upon by septa angles and narrower than length of dactylotomes, which are not expanded at outer end; dactylotomes very shallow.....*solida*
- b*<sup>2</sup>. Gastropore funnel shaped, its mouth not encroached upon by septa angles, as wide as length of the dactylotomes which are expanded at outer (dactylopore) end (compare *pacifica*).....*verrilli*
- a*<sup>3</sup>. Ampullae sunken in coenosteum, not forming superficial blisters (see *solida* and *verrilli*).
- b*<sup>1</sup>. Regularly one gastrostyle to each gastropore.
- c*<sup>1</sup>. Dactylotomes not unequal in length (so that cyclosystem is more or less asymmetrical).
- d*<sup>1</sup>. Gastropore cylindrical, fairly deep, without a differentiated style chamber (compare *verrilli*).....*pacifica*
- d*<sup>2</sup>. Gastropore relatively shallow, cup-shaped, the top of the large gastrostyle partly hidden by constricted sides of the pore; large style chamber nearly filled by the style.
- e*<sup>1</sup>. Colonies branched.....*venusta*
- e*<sup>2</sup>. Colonies encrusting (compare *papillosa*).....*petrograpta*
- c*<sup>2</sup>. Dactylotomes unequal; gastropore narrowly funnel-shaped.
- d*<sup>1</sup>. Colony normally large, branching; top of gastrostyle not encroached upon by outgrowths from side of gastropore; therefore no clearly differentiated style chamber...*californica*

- d*<sup>2</sup>. Colony encrusting, thin; cyclosystems small, the gastrostyle encroached upon by outgrowths from side of gastropore, forming a style chamber.
- e*<sup>1</sup>. Gastrostyle smaller, not completely filling style chamber or the passage into gastropore proper.....*papillosa*
- e*<sup>2</sup>. Gastrostyle more robust with more rounded summit; gastropore less funnel shaped and more cylindrical....*petrograpta*
- b*<sup>2</sup>. Normally more than one gastrostyle in a majority of gastropores, usually 3 to 7 (upward of 12). Colony encrusting.....*porphyra*

### Genus CRYPTOHELIA Milne Edwards and Haime

*Cryptohelia* MILNE EDWARDS and HAIME, Compt. Rend. Acad. Sci., vol. 29, p. 69, 1849 (type: *Cryptohelia pudica* Milne Edwards and Haime).

#### CRYPTOHELIA TROPHOSTEGA, new species

#### PLATE 62, FIGURES 1-8; PLATE 63

*Diagnosis*.—Flabellum massive, with robust anastomosing branches and large cyclosystems on both sides of colony; cyclosystems wide-mouthed, rather shallow, with a small ventral chamber not in direct communication with the 10 to 20 dactylopores; lid, when fully grown, nearly as large as extreme diameter of cyclosystem and containing 4 to 11 male ampullae or a single large female ampulla; very numerous nematophores on all parts of colony.

*Description*.—As compared with *C. pudica* Milne Edwards and Haime (1850, p. 69, pl. 3, figs. 1-1*c*) (pl. 64, fig. 1) the colony is much more massive in every respect and the cyclosystems are conspicuously larger. Plate 63 shows the anterior face of type colony where cyclosystems are more numerous than on the back. Type, 110 mm high and 150 mm wide; diameter of main trunks 17 to 20 mm; of branchlets 2 to 5 mm.

The following figure references are all to plate 62. Cyclosystems subcircular to oval, often irregular (fig. 7), the lid slightly smaller, convex, and of the same general contour (figs. 1, 7, 8). Rather frequently the distal margin of the lid fuses to the edge of cyclosystem in various ways (figs. 2, 7), leaving two lateral entrances to the cyclosystem. The more distally situated cyclosystems have a definite stalk (fig. 6) or have the margin slightly raised above the general level of branchlet; on the larger branches the margin is flush with the general surface. The number of dactylopores is quite variable, generally 10 to 20; usually in well-formed systems 16 to 20.

The relation of dactylopores to gastropore, and form of latter, are best appreciated from figures 4 and 5. The ventral chamber (*vc*) is very small, and there is no conspicuous channel leading into it from bottom of dactylopore as figured by Moseley (1879, pl. 35, fig. 7*c*) for *C. pudica* (= *C. moseleyi* Hickson and England). The diaphragm separating the upper from the lower chamber has a circular or occa-

sionally oval orifice with small accessory perforations. The margin of the orifice is usually entire but may be irregular or even deeply indented. Diameter of larger cyclosystems 2 to 3 mm; of the smaller about 1.5 mm; depth variable, usually less than extreme width of cyclo-system but more than half that width—around three-fifths to four-fifths of the width.

In an alcoholic specimen the prominent tentacular dactylozooids are bent over the retracted gastrozoid. These dactylozooids emerge from the dactylotome at a considerable distance below the margin of cyclo-system (fig. 5*d*) not nearly even with margin as figured by Moseley for *C. moseleyi* (1879, pl. 42).

The ampullae of both sexes are lodged in the swollen lid and its stem. In the male type colony there are upward of 11 (fig. 1). I have found as few as 5. In the rather small lid, marked *a* in figure 7, there were six ampullae, of which three were in the lid proper and three in the vertical portion. The swelling which indicates these stem ampullae is shown in figures 4 and 6. In the bottom of each ampulla (fig. 1) is a small natural aperture. Figure 3 shows a vertical section of a cyclo-system in which the lid has attachments on opposite sides as in figure 2.

There are two fragments of a female colony 50 by 40 mm and 45 by 30 mm. The large ampulla occupies the lid and stem, the size varying with the maturity of contents. Several ampullae examined contained a mature planula similar to that figured by Moseley (1879, pl. 42), its ectoderm crowded with elongate nematocysts. After the escape of the planulae the remains of the lid are absorbed or else sloughed off. It then regenerates from the base of stem. This is indicated by the number of cyclosystems with budding or partly developed lids. The ampulla originates in the bend of the stem. As the lid grows it enlarges, or more correctly, perhaps, the development of the embryos occasions the extension of the ampulla and hence the growth of the lid. The ampulla extends only a short distance into coenosteum at base of stem.

Thickly sprinkled all over the coenosteum are small shallow pits 0.07 to 0.11 mm in diameter, the nematophore pits. There is usually a fairly definite row of them on the margin of the lids. They are less conspicuous than in figure 7. The surface of the coenosteum under low magnification is smooth, but under high shows fine low anastomosing ridges, 0.05 to 0.08 mm in diameter.

Color of dried colony, yellowish white, which bleaches to pure white in sodium hypochlorite solution.

*Type*.—U.S.N.M. no. 42876.

*Type locality*.—Station 3480, Amukta Pass, Aleutian Islands, lat. 52°06' N., long. 171°45' W., 283 fathoms, black sand and rocks; bottom temperature not recorded.

*Specimens examined.*—The type and several small fragments from another male colony; two female fragments.

*Remarks.*—Although this species is in the same section of the genus as *C. pudica* Milne Edwards and Haime (not Moseley) the two are entirely different. I have specimens of *C. pudica* (pl. 64, fig. 1) taken by the *Albatross* at station 5423, Sulu Sea, 508 fathoms, gray mud and coral sand, bottom temperature 49.8° F. The colony is delicate, with longitudinally striated stems, and many of the cyclosystems are supported by relatively long slender pedicels. The cyclosystems are 1 to 1.3 mm broad, have about 15 dactylopores, and the lid stands higher above the cyclosystem than in *trophostega*. These mature lids completely cover the cyclosystem. The female ampullae are very convex, almost subhemispherical, slightly uneven. The free edge of the lid extends in front of the ampulla like the visor of a miniature jockey cap. *Nematophore pits are absent.* On this specimen of *pudica* are lids in all stages of growth, starting from small lobes on the side of cyclosystem. In *C. pudica* the cyclosystems all turn to the front of the colony. Enlargement of figures of plate 64 is twice that of plate 63.

A species I have provisionally identified as *C. japonica* (Milne Edwards and Haime) (pl. 64, figs. 2–4) can be distinguished from both *pudica* and *trophostega* by the size of cyclosystems and surface texture of coenosteum and by the small lids, which do not contain ampullae. Some cyclosystems have no lid. In others the lid begins as a lobelike outgrowth of a wider septum between two dactylotomes. The male ampullae are imbedded in the coenosteum between the cyclosystems and are evident superficially only as slight irregularities of surface. Diameter of cyclosystem 1.5 to 1.8 mm; dactylopores 10 to 20. Surface of coenosteum coarsely vermiculated but not longitudinally striated. (*Albatross* station 4890, 10 to 12 miles southwest of Goto Islands, Eastern Sea, lat. 32°26'30'' N., long. 128°36'30'' E., 135 fathoms, rocky; bottom temperature 52.3° F. Station 4924, in Colnett, or Vincennes, Strait, 30°5' N., 130°21'20'' E., 159 fathoms, rocky; bottom temperature 55.8° F.)

Hickson and England (1905, p. 21) in discussing specimens of *C. pudica* remark that "the peculiarities of this species are its robust growth and the large size of the cyclosystems." Everything in nature is, of course, relative. As compared to *C. trophostega* the cyclosystems of *pudica* are small and its growth scarcely robust. I have inserted on plate 64 (fig. 5), enlarged twice natural size as are the other figures, a photograph of *Cryptohelia gigantea*, new species, from station 2818, Galapagos Islands, lat. 00°08' S., long. 90°06' W., 392 fathoms, white and black sand; bottom temperature 43.9° F. Type, U.S.N.M. no. 43273. Cyclosystems 3.5 to 5 mm in diameter, funnel-shaped, with 20–25 long, shallow dactylotomes sloping evenly down to gastrostome proper. At this point the very thin ridges separating the



dactylotomes are bound together by a narrow lime-lattice, below which the pores communicate with the spacious ventral chamber, the walls of which are spongy and deeply fenestrated. *There is no ledge or diaphragm separating the ventral chamber from the part above, as in trophostega.*

The lid is occupied by a single large female ampulla which extends into stem but not below. Its dorsal wall is stout and its inner surface is spongy and fenestrated. The coenosteum is white, marked by fine, rounded longitudinal ridges. There are no nematophore pits.

This species is really robust.

#### Genus ERRINOPORA Fisher

*Errinopora* FISHER, Ann. Mag. Nat. Hist., ser. 10, vol. 8, p. 397, 1931 (type: *Errina pourtalesii* Dall).

*Protoerrina* BROCH, Einige Stylasteriden (Hydrokorallen) der ochotskischen und japanischen See, p. 59, 1935 (type: *Protoerrina stylifera* Broch).

*Diagnosis.*—Resembles *Errina* (including *Labiopora*) in having a gouge-shaped projecting lip to each major dactylopore but differs in the presence of a well-developed spiculate dactylostyle; no differentiated cuplike cyclosystem, although where the pores are not crowded several dactylopores encircle a gastropore; tip of gastrostyle flush with surface or sunken in an undifferentiated depression; fewer scattered tiny dactylopores without projecting lip; coenosteum spongy reticulate superficially, compact centrally. The channel of the dactylostyle is not definitely oriented either toward the end of the branch or in the opposite direction, as in most species of *Errina*.

So far as now known, this genus is confined to the north Pacific region. The most generalized or primitive species is *E. stylifera* (Broch).

#### ERRINOPORA STYLIFERA (Broch)

PLATE 65, FIGURE 1; PLATE 69, FIGURES 3, 3a

*Protoerrina stylifera* BROCH, Einige Stylasteriden (Hydrokorallen) der ochotskischen und japanischen See, p. 59, fig. 1, 1935; Untersuchungen an Stylasteriden, p. 101, fig. 32, pl. 13, fig. 40, 1936.

*Diagnosis.*—Colony subflabellate; branches coarse; color pale pink; dactylotomes not very prominent; gastropores deep, the apertures not sunken in concavities; gastrostyle broadly lanceolate, not reaching mouth of pore; female ampullae very numerous, superficial, large, the floor beset with numerous pronged spicules; coenosteal surface spongy.

*Description.*—Typical colony 70 mm high and 70 mm broad, subflabellate, with three principal branches, which divide dichotomously two or three times, the branches diminishing gradually in size and ending in rounded, sometimes slightly broadened tips. Diameter of trunk 10 by 15 mm; of terminal branches 4 or 5 mm.

The surface is covered with thin-walled, crowded, blisterlike female ampullae 1 to 1.6 mm in diameter; many are so close as to be in contact. Scattered irregularly among these, sometimes in series, are deep gastropores each with one or two associated dactylopores of full size forming a low scoop-shaped protuberance. The slit points toward a gastropore and in some instances is confluent with it but is separated by a sunken partition. Some of the gastropores have 1 to 3 smaller dactylopores (pl. 69, fig. 3) associated with them to form a primitive sort of cyclosystem. At the base of the colony, on the large trunk and branches where there are few or no ampullae, the gastropores are surrounded by 3 to 6 symmetrically placed narrow dactylostomes with only a very slight lip at the outer end (much less than in *E. pourtalesii*).

The gastropores are 0.25 to 0.35 mm in diameter and about twice as deep (pl. 69, fig. 3a). The style is 0.34 to 0.4 mm in length, spiculate, pointed; the tip reaches a little more than halfway to mouth of pore, while the width of the style is about two-thirds that of pore, or less in the case of unusually slender styles. Normally the gastrostome is on a level with the general surface rather than in the bottom of a concavity.

The characteristic feature of the dactylopore is that it projects much less prominently than in the other three species, even when the slit is tilted at a broad angle with the surface. Frequently the slit lies at a sharp angle, when its marginal projection or lip is slight. The dactylostyle is a long narrow cheval-de-frise of delicate spicules, about 0.1 mm long.

The female ampullae are very prominent, 1 to 1.6 mm in diameter and about one-half as deep. Many, but apparently not all, have the floor crowded with upright irregularly pronged spicules about 0.17 mm long. The larger ampullae have the roof, which is thin, somewhat flattened and without prominent protuberances. Male ampullae smaller, less prominent.

The coenosteum is hard, but the surface is rough, irregularly fenestrated, and spongy in texture, the dactylopore lip having a crystalline, sugary appearance. Here and there small roundish pores, apparently secondary dactylopores, penetrate the coenosteum.

Color of coenosteum pale pink, which is slightly intensified by immersion in sodium hypochlorite; ampullae yellowish.

*Type locality*.—Okhotsk Sea, lat. 56° 10' N., long. 143° 15' E., 182 meters; temperature at 165 meters, 0.51° C.

*Specimens examined*.—Station 5016, 2 fragments; station 5017, 3 fragments.

*Remarks*.—The second fragment from station 5016 has very few ampullae, which cause only a slight swelling of the surface, the main

portion of the cavity being sunken beneath the surface. They are about two-thirds the diameter of those of the other specimen and are probably male ampullae.

This species resembles *nanneca* more than *pourtalesii* or *zarkhyncha*. It differs in the form of colony, color, and details of the pores. For instance, the dactylopore lip is lower, the gastrostyle is more robust, and the dactylotomes are arranged around the gastropore in a primitive sort of cyclosystem. Some such organization may well have preceded the specialized structure characteristic of *Stylaster*, *Allopora*, and *Cryptohelia*.

This species is known only from the Okhotsk Sea. Dr. Broch records specimens also from lat. 54° 36' N., long. 143° 48' E., 165–150 meters.

ERRINOPORA NANNECA, new species

PLATE 66, FIGURE 1; PLATE 67; PLATE 69, FIGURES 2, 2a

*Diagnosis*.—Colony dendritic, flabelliform, yellowish buff; gastropores extremely small (0.16 to 0.2 mm in diameter), relatively deep, with a slender sharp style reaching about halfway to aperture; dactylotomes projecting but smaller than in *pourtalesii*; when dactylopores become crowded the styliferous furrow is oriented toward end of branchlet; female ampullae relatively large, blisterlike with thin wall; coenosteum solid, the surface minutely roughened, microscopically porous.

*Description*.—The type colony is 130 mm high and 80 mm broad. The three main branches with their branchlets lie in the same general plane, so that the colony tends to be flabellate. The main trunk of the colony is 18 to 25 mm thick, slightly compressed beyond the base, this compression becoming more and more pronounced until the distal or top branchlets are decidedly flattened or compressed, with truncate or rounded ends. Below these flattened terminal branches, others are more nearly terete. Most of the zooids are on one face of the colony, which may be called the front. On the back the pores are found usually near the margins of the flattened branches. Even the backs of the slenderer branchlets are fairly free from pores except near the tips.

On the branchlets, the furrow of the projecting dactylopore is generally directed toward the end. On the main branches where they are less crowded (except for abundant ampullae) the furrow may be turned in any direction, depending upon the position of the associated gastropore. Where the gastropores are scattered, as on the trunk and main branches, 2 or 3 small dactylopores are associated with a gastropore, but the furrow does not always face the gastropore—it may in fact be turned directly away from it.

The gastropores are very small, 0.13 to 0.18 mm at the orifice and 0.5 to 0.7 mm deep. A few reach 0.2 mm in diameter. The gastrostyle is slender, very sharp, and in the deepest pores reaches about halfway to the orifice. The furrow of the dactylo pore is about 0.1 mm broad, and the entire projecting process is 0.3 to 0.45 mm broad at the end. Along the bottom of the furrow is a cheval-de-frise of delicate spicules, the dactylostyle, which does not reach the distal end of the furrow (pl. 69, fig. 2a). Scattered, very small pores, one-fourth to one-fifth the diameter of the gastropores, probably represent secondary dactylo pores and are entirely without projecting lip.

The female ampullae form blisterlike, dome-shaped prominences, 0.8 to 1.5 mm in diameter, crowded on the front face of the main branches, and to a less extent on the back. In dried specimens they are conspicuous by reason of their lighter color. There are commonly a number of prominences on the surface of the ampullae as indicated in plate 69, figure 2.

The coenosteum is hard and very solid, but the surface is spongy, intricately fenestrated, and minutely rough in texture, owing to very tiny, crowded, irregular, branched spicules. The surface of the distal branches is of a coarser texture than that of the trunk where the interstices are smaller and the spicules more compact.

Color of dried colony yellowish buff (capucine buff on the lighter parts to apricot buff and zinc orange on the darker; Ridgway's nomenclature).

*Type*.—U.S.N.M. no. 42875.

*Type locality*.—Station 3599, Bering Sea, lat. 52°05' N., long. 177° 40' E., 55 fathoms, rocky, fine sand, shells.

*Specimens examined*.—The type (pl. 66, fig. 1), paratype (pl. 67), and 5 colonies from station 3599. Also from station 4777, 3 colonies, fragments, and 2 very small colonies on pebble with *Allopora verrilli*.

*Remarks*.—The yellowish color, tiny gastropores and dactylo pores, and large female ampullae are trenchant characters that separate this species from *pourtalesii*, which is light pink. In *pourtalesii* the gastropores are 0.25 to 0.35 mm in diameter and the robust style nearly fills the cavity, whereas in *nanneca* the pores are about 0.17 mm in diameter with a very slender style. The dactylostyle is relatively smaller than in *pourtalesii*.

ERRINOPORA ZARHYNCHA, new species

PLATE 68; PLATE 69, FIGURE 1

*Diagnosis*.—Colony branching, strongly flabelliform, the branches relatively massive, more or less compressed, a few times dichotomously divided; projections large, ordinarily 1 to 2 mm long and

0.6 to 1 mm broad at the end; gastropores 0.3 to 0.5 mm in diameter and about twice as deep; style slender; distal dactylotomes usually (but not invariably) oriented toward end of branch or sidewise toward margin; male ampullae very small, inconspicuous, about the diameter of a gastropore; coenosteum with a fenestrated, or spongy, rough surface; internally solid, fine grained.

*Description.*—The type colony is 140 mm high and 185 mm broad and consists of a stout trunk (20 by 15 mm thick) and massive, compressed, dichotomously divided, terminally blunt branches lying in one plane so that the general form is strongly flabellate. The proximal branches are 20 to 25 mm broad and about 15 mm thick. The trunk is devoid of pores (though there are faint scars of old ones), but all surfaces of the branches are crowded with coarse projecting dactylotomes standing singly or coalesced into groups of 2 to 8 or 10. On the front of the colony the scoop-shaped dactylotomes are about one-third to one-half longer than on the back.

On the proximal part of the main branches, the dactylotomes are not oriented in any definite direction; but distally the groove is usually turned toward the end of the branch, or sidewise toward the margin, as is indicated in the photograph. The gastropores are irregularly distributed in the deep and rather narrow spaces between the dactylotome projections; but at the base of the main branches near the trunk, where the zooids are uncrowded, 2 to 7 low dactylopores may irregularly surround a gastropore in a primitive cyclosystem.

The gastropores are unequal in size, the diameter at mouth varying from 0.3 mm to 0.5 mm, with a few as small as 0.21 mm. The majority are around 0.4 mm. The depth is a little hard to determine but is generally about twice the diameter at mouth. The gastrostyle is a fairly sharp one, rather slender, not filling the cavity. It extends rather more than halfway to orifice. The furrow of the dactylopore (i. e., the dactylotome), at the end of the projection, is about 0.5 mm deep and 0.3 mm wide. Length of projection varies according to position; the longest are about 2 mm. The dactylostyle is a very narrow, carinate cheval-de-frise of delicate, short spicules, which in the longer dactylotomes extends about half the length of the furrow and in the shorter ones about three-fourths. Scattered, very tiny pores may represent secondary dactylopores.

The ampullae (probably male) are inconspicuous and relatively very small, being simply slight swellings at the base of the dactylopore projections, the cavity subspherical with a diameter about that of a larger gastropore. The wall is very delicate—a fine, irregular grille.

The coenosteum is hard and very solid, but the surface is spongy or minutely fenestrated, with irregular trabeculae and tiny raised irregular processes. After cleaning with sodium hypochlorite solution the

thin walls of the ampullae are perforated by irregular pores forming a sort of grille work. The surface of the stem is hard, fairly smooth, not at all fenestrated.

Color of dried colony, ochraceous-buff.

Type.—U.S.N.M. no. 42874.

Type locality.—Station 3480, Amukta Pass, Aleutian Islands, lat.  $52^{\circ} 06' N.$ , long.  $171^{\circ} 45' W.$ , 283 fathoms, black sand, rocky.

Specimens examined.—The type and three fragments from same locality.

Remarks.—This species can be distinguished by the very large dactylopore projections, which are relatively gigantic when compared with those of *E. pourtalesii* and *E. nanneca*. But relative to the size of the groove the dactylostyle of *zarhyncha* is much smaller than in *pourtalesii*. It is narrower and does not extend so far toward the end of the spoutlike process. In *zarhyncha* the gastrostyle is slenderer and more tapered than in *pourtalesii* and of a coarser texture; it does not fill so much of the gastropore, or extend so far toward the orifice.

#### ERRINOPORA POURTALESII (Dall)

PLATE 65, FIGURE 2; PLATE 66, FIGURE 2; PLATE 70, FIGURES 1-1a

*Errina pourtalesii* DALL, Proc. Biol. Soc. Washington, vol. 2, p. 114, 1884.

*Errinopora pourtalesii* FISHER, Ann. Mag. Nat. Hist., ser. 10, vol. 8, p. 397, pl. 16, figs. 4-4b; pl. 17, figs. 7, 7a, 1931.

Diagnosis.—Characterized by its pink color, subterete, dichotomously dividing, pronglike branches, small female ampullae, and prominent dactylotome projections, larger than in any species except *zarhyncha*.

Description.—A nearly perfect colony was brought up on rock-cod lines off Point Sur (25 miles south of Monterey Bay), Calif., from a depth of between 50 and 90 fathoms. It rests on an irregular, deeply fenestrated base of dead hydrocoral thickly encrusted with sponges, bryozoans, serpulid tubes, barnacles, brachiopods, and solitary corals (*Paracyathus*). The horizontal dimensions of the living portion are 265 mm by 130 mm; total height 180 mm; the living portion 100 mm. There are very many subterete, round-tipped, one to four times dichotomously branched prongs arising from the very irregular, fenestrated, encrusting base, which, as above stated, rests on "dead" calcareous foundation. The main branches are 10 to 12 mm in diameter; the terminal branchlets 4 to 6 mm. Small colonies from off the Farallone Islands, Calif., have only a few branches and measure 35 to 75 mm in height.

The branches are rough from very numerous scoop-shaped projections, outgrowths of the margin of the larger dactylopores. The hollow of the scoop, which is the dactylotome, is oriented in every direction around a circle, and along its bottom is a slight ridge carry-

ing a cheval-de-frise of tiny spicules—the dactylostyle. Irregularly in depressions among the projections are the ovoid hirsute gastrostyles. Here and there are tiny secondary dactylopores without projecting lip, or with only a rudimentary one. In the latter a very tiny style can be detected.

On the basal part of the colony where there is no crowding (pl. 66, fig. 2) one can find numerous primitive cyclosystems composed of a central gastrostyle with 2 to 5 associated projecting dactylotomes oriented so that the slit and its style face toward the gastrostyle, the top of which may be in the bottom of a very shallow depression or else nearly flush with the general surface of the coenosteum. This is a more generalized condition than in *Allopora*, where the dactylopores are coordinated with the gastropore to form a circumscribed cup. The simpler arrangement suggests an ancestral stage of both genera.

In the large colony much of the space between the projecting dactylotomes is occupied by ampullae, probably female, crowded so close together that only a thin, often perforated grillelike wall separates them. The external wall is also a perforated grille. The subspherical cavity varies 1.5 to 3 times the diameter of an average gastropore. In a cleaned specimen these crowded ampullae have almost a frothy appearance (pl. 70, fig. 1*a*, *a*). In a small specimen from station 3159 are smaller ampullae, which are probably male (pl. 70, fig. 1*a*). These form a slight convexity, often at base of a projection, and the cavity varies in diameter from a little less to a little more than that of a gastropore.

The surface of the coenosteum is minutely fenestrated and spongy, with branched processes more irregular in the hollows than on the projections and more pronounced on the distal than on proximal parts of branches.

Color of dried colony, pink, varying from near eosine pink to rose pink of Ridgway's nomenclature. One small specimen is jasper pink.

*Type*.—In the United States National Museum and Museum of Comparative Zoology. "A large stone with several specimens upon it was obtained by Count Pourtalès in 1873, and is now in the Museum of Comparative Zoology." A small fragment of this, now in the National Museum, was used as the type.

*Type locality*.—50 to 100 fathoms about the Farallone Islands, Calif.

*Specimens examined*.—The type. Also from Point Sur, Calif., 50 to 90 fathoms, snagged by rock-cod fisherman of Vito Bruno's, Monterey, Calif., large colony, gift of Dr. G. Van Wagenen; station 3158, 8 small specimens; station 3159, 5 small colonies; Gulf of Georgia, A. Agassiz (no other data), 1 large colony, Museum of Comparative Zoology.

Genus **DISTICHOPORA** Lamarck

*Distichopora* LAMARCK, Histoire des animaux sans vertèbres, vol. 2, p. 198, 1816  
(type: *Madrepora violacea* Pallas).

**DISTICHOPORA BOREALIS**, new species

PLATE 70, FIGURE 3; PLATE 71; PLATE 72; PLATE 73

*Diagnosis*.—Resembling *D. sulcata* Pourtalès but differing in having the marginal sulcus about twice as broad, larger gastropores, still more prominent dactylopore projections, and much more strongly corrugated ampullae; surface of coenosteum minutely spiculated rather than uneven and glossy.

*Description*.—The colony branches mostly in one plane after the habit of typical *Distichopora*, but the branches are sometimes twisted or bent. At the base of the fragment from station 4781 (pl. 71, fig. 4) two of the main stems anastomose, and the neat flabellate structure is interrupted in the manner shown by the photograph.

The gastropores lie close together in a well-defined sulcus, the raised, rough borders of which are occupied by a series of tilted, slitlike dactylopores (or dactylotomes) oriented transversely or oblique-transversely to long axis of branch. Each dactylopore forms the aperture of a gouge-shaped projecting lip, as in *Errinopora*, these projections becoming more and more prominent on the distal portion of branchlets. Here the margins of branchlets in profile are strongly dentate on account of the dactylopore processes (pls. 72, 73).

The dactylotomes are about half as long as width of gastropore (varying one-third to two-thirds). Gastropores (from 0.25 to 0.425 mm in width) are spaced usually one-half to their own diameter apart. The spacing of dactylotomes is irregular, but there is frequently one on either side opposite a septum between two gastropores; and one, or occasionally two, on either side, corresponding to the gastropore. There are no dactylostyles.

The gastropores are very deep, slightly curved, and descend at a sharp angle to long axis of branch. Most of them end at center of branch, being separated from the series of opposite side only by a thin septum. The walls are beset by crowded short irregular spicules. The gastrostyle is very slender, usually long, and bristling with oblique sharp delicate spicules. The tip may be seen in a cleaned specimen by looking into the gastropore on the axis of its slant. Of sporadic occurrence on the front and back of larger stems are primitive cyclo-systems consisting of a gastropore (sometimes 2 or 3 of unequal size) surrounded by upward of 10 dactylopore projections, with the dactylotomes turned toward the gastropore. These are usually on a slight convexity and are the first appearance of new branchlets. A similar structure is found on some specimens of *D. violacea* forma *coccinea* (U.S.N.M. no. 8978, Tahiti).



The male ampullae (pl. 71, fig. 3; pl. 73) are superficial, convex, with a ridged or corrugated surface. Diameter of ampulla about 0.5 mm; dorsal wall thin; inner surface compact. The female ampullae (p. 70, fig. 3; pl. 71, figs. 1, 2, 4; pl. 72) are strongly convex, the surface traversed by prominent, interrupted or continuous, often sharp ridges or crests; or the surface is irregularly corrugated with occasional tubercles. Diameter of ampulla 1 to 1.25 mm or about twice that of the male ampullae; dorsal wall thicker than in male; inner surface fenestrated, often with irregular branched spicules, which anastomose into a wide-meshed spongy superstructure on the wall proper.

The texture of the coenosteum of branchlets is well shown by plates 72 and 73. On the main branches the coenosteum is firmer, but the surface is not smooth to the touch, nor is there any of the slight gloss or "finish" that is found in *D. sulcata*. The lighter bands of the vermiculation apparent in plates 72 and 73 are due in part to the more porous structure of the surface layer and in part to microscopic spicules. These are more obvious (under high magnification) on the dactylotome projections and on the ridges traversing the ampullae (pl. 70, fig. 3).

Color of dried specimens: Cartridge buff (pl. 71, fig. 3), warm buff (pl. 71, fig. 1), capucine buff (pl. 71, fig. 4); Ridgway's nomenclature.

Type.—U.S.N.M. no. 43274.

Type locality.—Station 3480, Amukta Pass, Aleutian Islands, lat. 52° 06' N., long. 171° 45' W., 283 fathoms, black sand, rocky.

Specimens examined.—From the type locality, three male and three female fragments (largest, the type, pl. 71, fig. 1); from station 4781, one colony (pl. 71, fig. 4).

Remarks.—I have compared specimens with examples of *D. violacea* (Pallas) Lamarck, *D. coccinea* Gray, and *D. nitida* Verrill—color variations of one reef and shallow-water Indo-Pacific tropical species, *D. violacea*. This species does not have dactylotome projections and has a smooth, purple, violet, rose, red, or deep apricot corallum. *D. gracilis* Dana (1846, p. 704, pl. 60, figs. 4, 5-5b), from Tuamotu Archipelago, is very small, the pale rose corallum being only 23 mm high. The gastropores (0.1 mm to 0.12 mm) are one-fourth to one-third the diameter of the average pores of *borealis*. They open in a shallow sulcus, and the dactylotomes have a slightly elevated lip. The relatively broad and low female ampullae sometimes occupy the entire breadth of a branch (pl. 75) and are not corrugated but are covered like the rest of corallum with microscopic convexities or bosses. *D. rosea* Kent (1871), from the east coast of Australia, is probably the same species. As Dana's figure of the type is very small, a photograph, enlarged five times, is given (pl. 75). Type of *D. gracilis* Dana is Mus. Comp. Zool. no. 5507.

Of the species described by Pourtalès from the West Indian region, *sulcata*, *foliacea*, *cervina*, *barbadensis*, and *contorta*, the north Pacific species shows resemblance only to *D. sulcata* (see pl. 74). In this species the dactylotomes are on projections that on the distal parts of branches approach the prominence of those of *borealis*, but when specimens are compared the gastropores of *borealis* are quite evidently at least 50 percent (sometimes 100 percent) wider than those of *sulcata* and the marginal sulcus, including the limiting dactylotome projections, about twice as broad as that of *sulcata*. The ridges that roughen the surface of the ampullae of *sulcata* are smaller, more numerous, rounded, less porous, with a surface polish and without the microscopic superficial spicules of *borealis*.

## LITERATURE CITED

- AGASSIZ, ALEXANDER, and POURTALÈS, LOUIS FRANÇOIS DE.  
 1874. Echini, erinoids, and corals. In *Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College*, no. 8, pp. 1-49, 15 figs., 10 pls. (Mem. Mus. Comp. Zool., vol. 4.)
- BROCH, HJALMAR.  
 1914. Stylasteridae. The Danish *Ingolf*-Expedition, vol. 5, pt. 5, 25 pp., 6 figs., 5 pls.  
 1918. Coelenterates in the publications of J. E. Gunnerus, a contribution to the history of Norwegian zoology. Kongl. Norske Vid.-Selsk. Skrifter, 1917, no. 4, pp. 1-17, 4 figs., 1 pl.  
 1932. Ueber einige geographisch interessante Fundstellen von Alcyonarien und Hydrokorallen im nördlichen Stillen Ozean. Explor. des mers d'URSS, fasc. 17 (1433), Inst. Hydrologique, Leningrad, pp. 81-86, 2 figs.  
 1935. Einige Stylasteriden (Hydrokorallen) der ochotskischen und japanischen See. Idem, fasc. 22, pp. 58-60, 2 figs.  
 1936. Untersuchungen an Stylasteriden (Hydrokorallen), Teil I, pp. 1-103, 32 text-figs., 13 pls. Norske Vid.-Akad. Skrifter, Mat.-Nat. Kl., no. 8. (October 1936.)
- DALL, WILLIAM HEALEY.  
 1884. On some Hydrocorallinae from Alaska and California. Proc. Biol. Soc. Washington, vol. 2, pp. 111-115. (Also in: Ann. Mag. Nat. Hist., ser. 5, vol. 13, pp. 467-471, 1884.)
- DANA, JAMES DWIGHT.  
 1846. Zoophytes. United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N., vol. 7, 740 pp., atlas (61 pls.).
- EHRENBERG, CHRISTIAN GOTTFRIED.  
 1834. Beiträge zur physiologischen Kenntniss der Corallenthierie im allgemeinen, und besonders des rothen Meeres, nebst einem Versuche zur physiologischen Systematik derselben. Abh. Akad. Wiss. Berlin, 1832, pp. 225-380.
- ESPER, EUGENIUS JOHANN CHRISTOPH.  
 1797. Fortsetzungen der Pflanzenthierie, in Abbildungen nach der Natur mit Farben erleuchtet nebst Beschreibungen, Theil 1, 230 pp. Nurnberg.
- FISHER, WALTER KENRICK.  
 1931. Californian hydrocorals. Ann. Mag. Nat. Hist., ser. 9, vol. 8, pp. 391-399, 3 pls.
- GRAY, JOHN EDWARD.  
 1847. An outline of an arrangement of stony corals. Ann. Mag. Nat. Hist., vol. 19, pp. 120-128.
- HICKSON, SYDNEY JOHN.  
 1900. The Alcyonaria and Hydrocorallinae of the Cape of Good Hope. Marine Investigations in South Africa, vol. 1, pp. 67-96, 6 pls.  
 1912. On the hydrocoralline genus, *Errina*. Proc. Zool. Soc. London, 1912, pp. 876-896, 3 pls.
- HICKSON, SYDNEY JOHN, and ENGLAND, HELEN MARY.  
 1905. The Stylasterina of the *Siboga* Expedition. *Siboga*-Exped. Monogr. 8, 26 pp., 3 pls.

## KENT, WILLIAM SAVILLE.

1871. On some new and little-known species of madrepores, or stony corals, in the British Museum collection. *Proc. Zool. Soc. London*, 1871, pp. 275-286, 3 pls.

## MILNE EDWARDS, HENRI, and HAIME, JULES.

1850. Recherches sur les polypiers; cinquième memoire. Monographie des oculinides. *Ann. Sci. Nat. Zool*, ser. 3, vol. 13, pp. 63-110, 2 pls.  
1857. Histoire naturelle des corallaires ou polypes proprement dit, vol. 2, 633 pp.  
1860. *Ibid.*, vol. 3, 560 pp.

## MOSELEY, HENRY NOTTIDGE.

1876. On the structure and relations of the alcyonarian *Heliopora caerulea*, with some account of the anatomy of a species of *Sarcophyton*; Notes on the structure of species of the genera *Millepora*, *Pocillopora*, and *Stylaster*; and Remarks on the affinities of certain Palaeozoic corals. *Philos. Trans. Roy. Soc. London*, vol. 166, pt. 1, pp. 91-129, 2 pls. (Abstract in: *Proc. Roy. Soc. London*, vol. 24, pp. 59-70, 1875.)  
1879. On the structure of the Stylasteridae, a family of the hydroid stony corals. *Philos. Trans. Roy. Soc. London*, vol. 169, pt. 2, pp. 425-503, 11 pls.  
1880. On the Hydrocorallinae. The voyage of H. M. S. *Challenger*, *Zoology*, vol. 2, pt. 1, pp. 11-101, 14 pls.

## POURTALES, LOUIS FRANÇOIS DE.

1867. Contributions to the fauna of the Gulf Stream at great depths. *Bull. Mus. Comp. Zool.*, vol. 1, no. 6, pp. 103-120.  
1868. *Idem* (2d ser.). *Bull. Mus. Comp. Zool.*, vol. 1, no. 7, pp. 121-141.  
1871. Deep-sea corals. In *Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College*, no. 4, 93 pp., 8 pls. (*Mem. Mus. Comp. Zool.*, vol. 2.)  
1878. Reports on the results of dredging under the supervision of Alexander Agassiz in the Gulf of Mexico, by the United States Coast Survey steamer *Blake*. *Bull. Mus. Comp. Zool.*, vol. 5, no. 9, Corals, pp. 197-212, 1 pl.

## QUELCH, JOHN JOSEPH.

1884. On new Stylasteridae, with remarks on some recently described forms. *Ann. Mag. Nat. Hist.*, ser. 5, vol. 13, pp. 111-117.

## RIDGWAY, ROBERT.

1912. Color standards and color nomenclature, 44 pp., 53 pls. (1,115 named colors). Washington.

## SARS, GEORG OSSIAN.

1873. Bidrag til Kundskaben om Dyrelivet paa vore Havbanker. *Forh. Vid.-Selsk. Christiania*, 1872, pp. 73-119.

## VERRILL, ADDISON EMERY.

1864. List of polyps and corals sent by the Museum of Comparative Zoology to other institutions in exchange, with annotations. *Bull. Mus. Comp. Zool.*, vol. 1, no. 3, pp. 29-60.  
1866. Synopsis of the polyps and corals of the North Pacific Exploring Expedition under Commodore C. Ringgold and Captain John Rodgers, U. S. N., from 1853 to 1856; collected by Wm. Stimpson, naturalist to the expedition; with descriptions of some additional new species from the west coast of North America. Pt. 3: Madreporaria. *Proc. Essex Inst.*, vol. 5, no. 3, pp. 17-50, 2 pls.  
1868. Review of the corals and polyps of the west coast of America. *Trans. Connecticut Acad. Arts and Sci.*, vol. 1, pt. 2, pp. 377-558, 6 pls.

## EXPLANATION OF PLATES

The drawings of details were made by the writer. The photographs were made in the photographic laboratory of the United States National Museum, with exception of plates 43, 65, 66, and 68 by G. E. MacGinitie and plates 58 and 60 by Beauford B. Fisher.

### PLATE 34

*Allopora campyleca*: 1, Portion of branchlet of male colony showing two cyclo-systems and associated ampullae,  $\times 20$ ; 1a, type, longisecton of a cyclo-system from side of rather small branch that necessitates the sharp curvature of gastropore,  $\times 20$ , gastrostyle 0.68 mm; 1b, a cyclo-system from main stem of type, with three male ampullae (two opened),  $\times 20$ ; 1c, type, three dactylo-tomes,  $\times 60$ , showing relatively small pores and small dactylostyle spicules; 1d, branchlet of female colony, showing cyclo-systems and associated female ampullae, the lowermost sectioned,  $\times 20$ , longest diameter of cyclo-system 1.2 mm; 1e, type, style and rudimentary style chamber characteristic of male colonies,  $\times 30$ , gastrostyle 0.68 mm; 1f, style characteristic of female colonies,  $\times 30$ , style 0.5 mm; 1g, longisecton of a cyclo-system of female colony,  $\times 20$ .

### PLATE 35

1-1d, *Allopora polyorchis*: 1, Type, a cyclo-system from the posterior face of a larger stem,  $\times 20$ , cyclo-system 0.93 by 1.1 mm, three male ampullae; 1a,  $\times 60$ , section of a style chamber viewed from above as well as from side, so that the style is considerably foreshortened, spicules shown projecting downward from gastropore wall; 1b,  $\times 20$ , cyclo-system and two female ampullae of specimen mentioned in text; 1c, type,  $\times 20$ , lateral face of a branchlet showing three irregular confluent cyclo-systems and an independent system with the more robust gastrostyles often found in irregular systems, male ampullae above on front of colony, those below on the back; 1d, type,  $\times 20$ , section of a rather deep cyclo-system with also on left a section of a dactylo-pore.

2-2c, *Stylaster cancellatus*: 2, Type,  $\times 20$ , lateral face of a small twig showing five cyclo-systems and female ampullae on front and back of twig, an ampulla opened on left, and end of branch at right; 2a, male specimen,  $\times 20$ , a shallow cyclo-system viewed in section, with two dactylo-pores in section; 2b, male specimen,  $\times 20$ , the terminal deeper gastropore of a small twig; 2c, male specimen,  $\times 10$ , lateral view of a fairly straight branchlet of the twig-net showing three cyclo-systems and male ampullae, the gastropore set obliquely as in 2a (note that this figure is half magnification of others).

### PLATE 36

*Allopora campyleca*: 1, Type, portion of male colony, front view; 2, fragment of female colony, back view showing ampullae. Natural size.

### PLATE 37

*Allopora polyorchis*: 1, Front view of type colony, male, 390 mm wide and 278 mm high; 2, tip of a terminal branchlet enlarged to show characteristic distortion of cyclo-systems (this is possibly from a different colony).

## PLATE 38

*Allopora polyorchis*: 1, Branchlet from type (pl. 37, fig. 1, arrow) showing abundance of male ampullae and their distribution, front view,  $\times 4\frac{1}{2}$ ; 2, terminal twigs from same fragment as pl. 37, fig. 2 (note male ampullae),  $\times 5$ .

## PLATE 39

*Stylaster cancellatus*: Front view of central portion of type fragment showing orientation of cyclosystems on anastomosing branchlets and the characteristic female ampullae,  $\times 5$ .

## PLATE 40

*Stylaster cancellatus*: 1, Paratype, front of fragment of male colony, natural size; 2, back of same colony,  $\times 5$ , this enlargement representing the obverse of the lower left quadrant of fig. 1; the heaviest branch (arrow) is the ascending central branch of fig. 1.

## PLATE 41

1-1d, *Allopora campyleca paragea*: 1, Type, one of the larger cyclosystems, with two male ampullae, from a small branch,  $\times 30$ ; 1a, a branchlet showing ordinary cyclosystems,  $\times 20$ , to agree with magnifications of figs. 2, 2c, and 2d; 1b, section of a small cyclosystem but not showing maximum curvature of pore,  $\times 30$ , style 0.5 mm long, *dp*=dactylopores, that on right is independent of a cyclosystem, section of male ampulla; 1c, style and style chamber of a larger cyclosystem,  $\times 30$ , showing maximum differentiation of style chamber; 1d, three dactylopores and gastrostome,  $\times 60$ , showing the short dactylotomes and maximum development of dactylostyles.

2-2e, *Allopora campyleca tyloia*: 2, Type, two of the peculiar large cyclosystems and associated female ampullae, the lowermost with roof removed to show fenestrated wall,  $\times 20$ , cyclosystem 1.5 mm in diameter; 2a, style and style chamber of a cyclosystem from branchlet of male colony,  $\times 30$ , showing only moderate development of spicules on wall of style chamber; 2b, view looking into gastropore from just above tip of style, showing the style chamber and the spiniform outgrowths from its wall (cf. fig. 3),  $\times 60$ , the outer line being the boundary of gastropore, here shown in cross section; 2c, a cyclosystem at tip of a lateral branchlet of largest fragment (male colony),  $\times 20$ ; 2d, one of the small cyclosystems from a peripheral branchlet and two male ampullae in profile,  $\times 20$ ; 2e, section of a cyclosystem, gastropore 1.85 mm deep, style 0.59 mm long,  $\times 20$ ; this view shows the deep-cut dactylotomes for comparison with those of *S. elassotomus*.

3, *Stylaster elassotomus*: Type, cross section of gastropore just above end of style showing spiculate outgrowths from wall of style chamber,  $\times 60$  (cf. fig. 2b).

## PLATE 42

1-1c, *Stylaster elassotomus*: 1, Type, a cyclosystem viewed directly from above showing the short dactylotomes and the flaring gastrostome of the larger systems,  $\times 20$ ; 1a, a portion of the above enlarged,  $\times 60$ ; 1b, longisecton of gastropore,  $\times 20$ , gastrostyle 0.45-0.5 mm long (see pl. 41, fig. 3) (the shallow dactylotomes are shown at top); 1c, branchlet with two cyclosystems and associated male ampullae,  $\times 20$ .

2-2b, *Allopora stejnegeri*: 2, Type, a large cyclosystem from a main stem,  $\times 20$ ; 2a, two female ampullae and two small cyclosystems from branch,  $\times 20$ ; 2b, section of cyclosystem and two ampullae,  $\times 20$ , the right ampullae being the normal female and the left the small sort mentioned in text.

- 3-3d, *Allopora brochi*: 3, Type,  $\times 60$ , portion of a cyclosystem showing details of four dactylotomes; 3a, type,  $\times 20$ , a full-sized cyclosystem and two female ampullae; 3b, type,  $\times 20$ , section of a cyclosystem and two ampullae; 3c, type,  $\times 20$ , a gastrostyle, showing also spicules on wall of style chamber; 3d, type,  $\times 20$ , one of the small gastrostyles mentioned in text.

## PLATE 43

*Allopora campyleca paragea*: Front view of type colony, natural size.

## PLATE 44

*Allopora brochi*: 1, Branch of type colony,  $\times 5$ ; 2, type colony, about natural size, taken  $90^\circ$  to left of viewpoint of fig. 1.

## PLATE 45

- 1, *Allopora brochi*: Type, slightly enlarged.  
2, *Allopora campyleca trachystoma*: Front of type (female), natural size.

## PLATE 46

*Allopora campyleca trachystoma*: 1, Front view of a fragment of male colony, natural size; 2, enlargement of right center of fig. 1,  $\times 5$ .

## PLATE 47

*Stylaster gemmascens alaskanus*: 1, Front view of a male colony,  $\times 2$ ; 2, enlargement of distal branchlets of fig. 1,  $\times 5$ ; 3, end of a female colony showing flattened branchlets, spiny outgrowths, and two ampullae,  $\times 5$  (this is the left distal branch of pl. 48, fig. 1).

## PLATE 48

*Stylaster gemmascens alaskanus*: 1, Front view of branch of female colony, paratype,  $\times 2$  (see pl. 47, fig. 3); 2, front view of portion of type fragment, male,  $\times 5$ .

## PLATE 49

- 1, *Stylaster elassotomus*: Type, front view,  $\times 1\frac{1}{4}$ .  
2, *Allopora moseleyana*: Female colony, from station 3480, front view,  $\times 2$ .

## PLATE 50

*Allopora moseleyana*: Fragment of a female colony (not of pl. 49, fig. 2), from station 3480,  $\times 5$ .

## PLATE 51

*Allopora moseleyana*: Type, male colony, from station 4781.

## PLATE 52

*Allopora moseleyana* forma *leptostyla*: 1, Fragment of male colony showing ampullae, front view,  $\times 2$ ; 2, most of type colony, front view,  $\times 1\frac{1}{2}$ ; 3, fragment of female colony, front view,  $\times 5$ .

## PLATE 53

1-1b, *Allopora moseleyana*: 1, Two cyclosystems of the type,  $\times 30$ , extreme diameter of cyclosystem including dactylopores 0.85-0.9 mm, diameter of style 0.25 mm, on left tubercles of coenosteum (a, ampulla; p, coenosteal pore); 1a,  $\times 30$ , sectioned cyclosystem with robust style 0.47 mm long, the ventral or bottom chamber of the gastropore shown darker; 1b,  $\times 30$ , sectioned cyclosystem showing also longitudinal section of dactylopores, style 0.6 mm long and ventral chamber of gastropore large; above the rim of cyclosystem is another intended to show the normal variation in depth of

cup, the bottom being the same for both (a, sectioned male ampulla *in situ*, 0.425 mm in diameter, showing laminated inner surface).

- 2-2b, *Allopora norvegica pacifica*: 2, A cyclosystem,  $\times 30$ , extreme diameter 0.8–0.85 mm, tip of gastrostyle seen in profile owing to curvature of pores; 2a,  $\times 30$ , slender style of specimen mentioned in text; 2b,  $\times 30$ , sectioned cyclosystem from male fragment with sectioned ampulla *in situ* (a), depth of gastropore 1.2 mm, length of style 0.6 mm.
- 3-3b, *Allopora boreopacifica*: 3, Sectioned cyclosystem,  $\times 30$ , showing on left a sectioned dactylopore and an isolated dactylopore; 3a, portion of branchlet bearing female ampullae,  $\times 30$ , uppermost cyclosystem 0.74 mm in diameter; 3b,  $\times 30$ , a sectioned female ampulla from same branchlet as fig. 3a.

## PLATE 54

- 1-1b, *Allopora campyleca trachystoma*: 1, Type, longisection of a cyclosystem,  $\times 20$ ; 1a, several female ampullae and a cyclosystem,  $\times 20$ ; 1b, smaller cyclosystem showing three outgrowths characteristic of smaller branchlets, from specimen figured on pl. 46,  $\times 20$ .
- 2, *Stylaster gemmascens alaskanus*: Three ampullae, probably male (indicated by arrow, pl. 47, fig. 2), seen somewhat more in profile; diameter of ampulla about 0.75 mm;  $\times 20$ .
- 3, *Allopora verrilli*: Cyclosystem of specimen from station 4777 figured on pl. 57, fig. 2,  $\times 30$ ; one dactylotome is imperfect.
- 4, 4a, *Allopora papillosa*: 4, Largest cyclosystem of type specimen,  $\times 30$ ; 4a, section of a cyclosystem showing characteristic gastrostyle in style chamber,  $\times 30$ .
- 5, 5a, *Allopora petrograpta*: 5, An unusually symmetrical cyclosystem showing large gastrostyle (some gastrostyles are smaller and some relatively larger than this),  $\times 30$ ; 5a, sectional view showing two female ampullae and a smaller cyclosystem with characteristic style,  $\times 30$ .

## PLATE 55

- 1, *Allopora norvegica pacifica*: Front view,  $\times 2$ , station 5016.
- 2, *Allopora boreopacifica*: Back of colony, natural size, station 5016.
- 3, *Allopora venusta*: Female from station 2875, front view,  $\times 2$ .

## PLATE 56

- Allopora stejnegeri*, type: 1, Portion of right branch of fig. 2,  $\times 4\frac{1}{2}$ ; 2, major portion of colony (base omitted),  $\times 2$ .

## PLATE 57

- Allopora verrilli*: 1, Male colony from Sucia Islands, Wash.,  $\times 3$ ; 2, smaller of two colonies from station 4777, female,  $\times 4\frac{1}{2}$  (the back of colony has nearly as many cyclosystems; in the other colony there is no differentiated front); 3, type specimen,  $\times 2$ , somewhat beach worn.

## PLATE 58

- Allopora californica*: Small portion of a large colony from Monterey Bay, Calif., mentioned in text; U.S.N.M. no. 43275;  $\times 2$ .

## PLATE 59

- 1, 2, *Allopora porphyra*: 1, Part of type colony,  $\times 6$ ; 2, another fragment of type colony,  $\times 3$ .
- 3, *Allopora papillosa*: Type,  $\times 6$ .
- 4, *Allopora petrograpta*: Part of type,  $\times 6$ .



## PLATE 60

*Allopora porphyra*, alcoholic specimen from Carmel Bay, Calif. (tissue considerably smooths the surface and partly obscures the calcareous papillae; a fragment of this colony is U.S.N.M. no. 43277): 1, Enlarged slightly over twice natural size; 2, a portion near center of fig. 1,  $\times 4$ .

## PLATE 61

- 1, 1a, *Allopora porphyra*: 1, A typical cyclosystem with four gastrostyles viewed directly from above,  $\times 30$ ; 1a, a section of a cyclosystem showing two gastrostyles and four dactylostyles. The dotted line crossing the gastrostyles indicates the bottom of the cup; the lower, dash, line is the bottom of the colony, which was here very thin; on the right an entire dactylopore is shown in section,  $\times 30$ .  
2, 2a, *Allopora venusta*: 2, A cyclosystem from above, specimen from off Cape Flattery,  $\times 30$ ; 2a, section of a cyclosystem for comparison with fig. 3b,  $\times 30$ .  
3-3b, *Allopora californica*: 3, Three cyclosystems of a specimen from Monterey Bay,  $\times 30$ ; 3a, a cyclosystem of the type,  $\times 30$ ; 3b, section of a cyclosystem, specimen from Monterey Bay,  $\times 30$ ; on either side are portions of female ampullae.

## PLATE 62

*Cryptohelia trophostega*: 1, A lid with dorsal wall removed to show the contained ampullae, the circular apertures of which are in the lower wall of each chamber and therefore pierce the lower wall of the lid directly over the gastropore,  $\times 15$ ; 2, a cyclosystem viewed from the side, showing a lid with two points of attachment, the spots indicating nematophore pits,  $\times 15$ ; 3, a section of a cyclosystem having a lid with two points of attachment, three ampullae (a) shown in section and at the bottom of the gastropore the very small ventral chamber (vc),  $\times 5$ ; 4, a cyclosystem viewed directly from above after removal of the lid in the stem of which are parts of three ampullae (a) (in the center of the gastropore is the round aperture leading to ventral chamber),  $\times 15$ ; 5, half of a cyclosystem sectioned in the plane x-x, fig. 4, but of a smaller cyclosystem; above are the dactylotomes, which do not communicate directly with the ventral chamber (vc),  $\times 15$ ; 6, a small cyclosystem at end of a branchlet, showing nematophore pits,  $\times 15$ ; 7, a portion of the main stem in a distal part of the colony showing variations in form of cyclosystems and the nematophore pits,  $\times 5$  (the pits are not so conspicuous as it is necessary to make them in the drawing; a, a lid with six ampullae mentioned in text); 8, a view of a fairly large cyclosystem from above with a lid in place, width of lid 2.8 mm,  $\times 15$ .

## PLATE 63

*Cryptohelia trophostega*: Type, anterior face, natural size.

## PLATE 64

1. *Cryptohelia pudica* Milne Edwards and Haime (but not of Moseley): Specimen from Sulu Sea, 508 fathoms,  $\times 2$ .  
2-4, *Cryptohelia japonica* (Milne Edwards and Haime): 2, 3, Specimens from station 4924, Colnett or Vincennes Strait, 159 fathoms; 4, from station 4890, Eastern China Sea, 135 fathoms.  $\times 2$ .  
5, *Cryptohelia gigantea*: Type, from station 2818, Galapagos Islands, 392 fathoms,  $\times 2$ .

## PLATE 65

- 1, *Errinopora styliifera*: Front view, slightly enlarged, station 5016.
- 2, *Errinopora pourtalesii*: Three branches of small colony from station 3159 (virtually the type locality),  $\times 3$ .

## PLATE 66

- 1, *Errinopora nanneca*: Type, front view,  $\times 1.4$ .
- 2, *Errinopora pourtalesii*: Main stem of small colony (pl. 65, fig. 2) showing primitive cyclosystems referred to in text.

## PLATE 67

*Errinopora nanneca*: Front view of paratype from station 3599,  $\times 1.3$ .

## PLATE 68

*Errinopora zarhyncha*: Front view of type, slightly reduced.

## PLATE 69

- 1, *Errinopora zarhyncha*: A group of gastropores and dactylopores,  $\times 15$ .
- 2, 2a, *Errinopora nanneca*: Three ampullae and neighboring dactylopores and gastropores,  $\times 15$ ; 2a, two gastropores and three dactylopores,  $\times 30$ .
- 3, 3a, *Errinopora styliifera*: 3, Portion of surface of terminal branch showing characteristic arrangement of gastropores and dactylopores of several sizes (the smoother swellings are ampullae),  $\times 15$ ; 3a, detail of a gastropore (in section) and, above, of several dactylopores (surface view),  $\times 30$ .

## PLATE 70

- 1, 1a, *Errinopora pourtalesii*: 1, Tip of a branchlet of specimen from Point Sur, Calif., showing the lipped dactylopores, dactylostyles, scattered circular gastrostyles, and female ampullae (a, a, a) with perforated wall (the small black spots are secondary dactylopores),  $\times 15$ ; 1a, from station 3159; above are two dactylopores, one showing style; below are two gastrostyles; two male ampullae, the thin wall of which has been removed;  $\times 30$ .
- 2, 2a, *Allopora porphyra*: 2, A cyclosystem drawn from life showing a partly expanded gastrozoid, with eight tentacles, and contracted dactylozoids; 2a, a cyclosystem drawn from life showing four gastrozoids, with five and six tentacles, and encircling them the mostly retracted dactylozoids,  $\times 30$ .
- 3, *Distichopora borealis*: Type, detail of a terminal branch showing female ampullae, dactylopores, and gastropores,  $\times 20$ .

## PLATE 71

*Distichopora borealis*: 1, Type, female, from station 3480,  $\times 1\frac{1}{2}$ ; 2, another female fragment from type locality,  $\times 1\frac{1}{2}$ ; 3, a male fragment from type locality,  $\times 1\frac{1}{2}$ ; 4, specimen from station 4781, female, natural size.

## PLATE 72

*Distichopora borealis*: Same specimen as pl. 71, fig. 2, enlarged five times to show texture of surface, female ampullae, and dactylotome projections along border of branches.

## PLATE 73

*Distichopora borealis*: Male specimen from station 3480,  $\times 5$ .

## PLATE 74

*Distichopora sulcata* Pourtalès: Specimen from station 2354, off Arrowsmith Bank, Yucatan, lat. 20°59'30'' N., long. 86° 23' W., 130 fathoms, natural size.

## PLATE 75

*Distichopora gracilis* Dana: Type, Mus. Comp. Zool. no. 5507, from Tuamotu Archipelago, U. S. Exploring Expedition,  $\times 5$ .

## PLATE 76

A comparison of the cyclosystems of five species of *Allopora*, enlarged approximately 30 times; for each species a surface view and a longitudinal section through gastropore and two dactylopores (*d*) are given to show form of gastropore and gastrostyle (*g*). The dactylotomes (*d*) are in sagittal section.

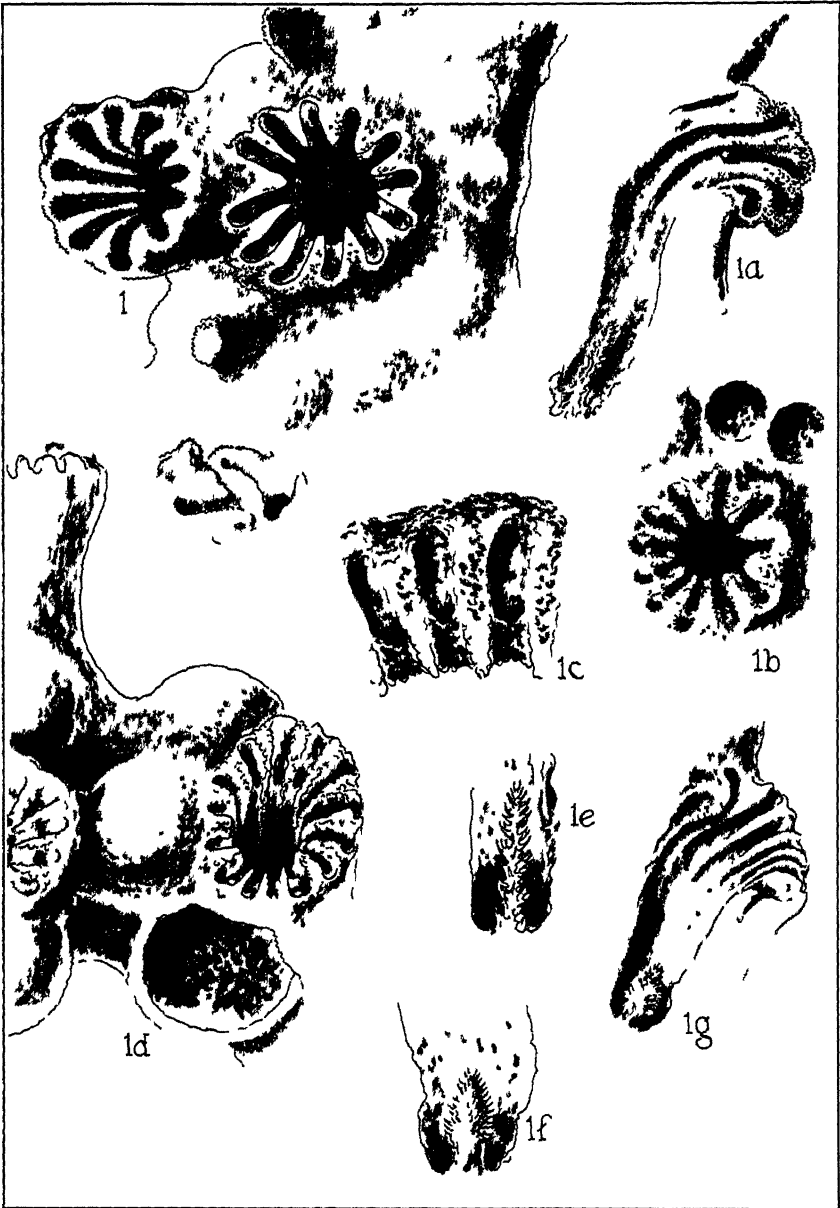
1, 2, *Allopora solida* (Broch): Cotype.

3, 4, *Allopora norvegica pacifica* (Broch): Figure 3 is from one of Dr. Broch's white specimens on which the cyclosystems are usually circular. The gastropore is curved so that the tip of the gastrostyle, in profile, is seen on the right side. Figure 4 is from one of Dr. Broch's rose specimens. In both of these the cyclosystems are larger than in examples from stations 5016 and 5017 (see pl. 53, fig. 2).

5, 6, *Allopora verrilli* Dall: 5, Specimen from Sucia Islands, Wash.; 6, from station 4777.

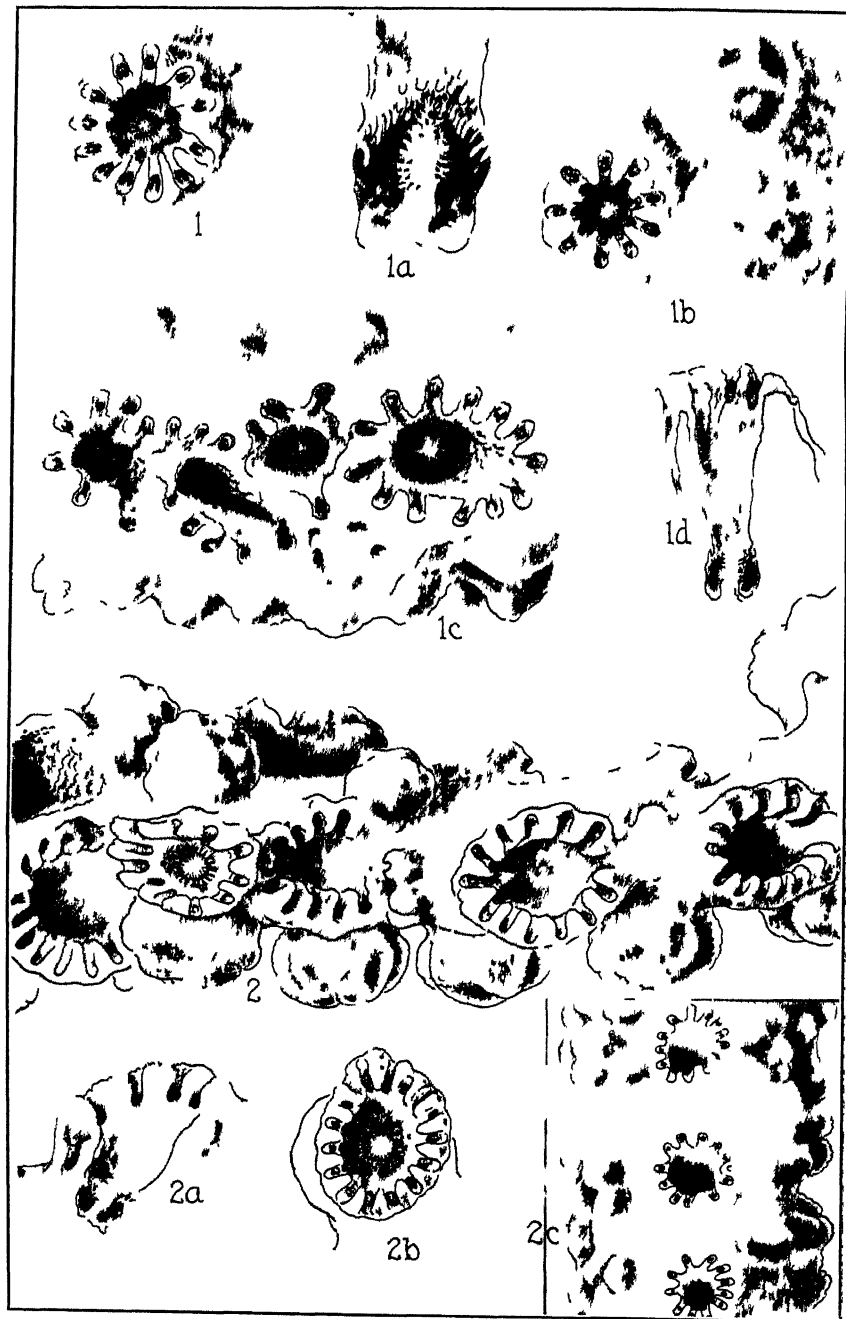
7, 8, *Allopora scabiosa* (Broch): Cotype. Figure 7 represents a large cyclosystem with a bent or curved gastropore, the sides of which are as steep as in figure 8. The ventral portion of the gastropore surrounding the style, which might reasonably be interpreted as a style chamber (cf. p. 515), is often not so sharply differentiated from the portion above. In such cases the gastropore is wider opposite the tip of style. In the engraving the roughness of the style-chamber wall is much overemphasized.

9-11, *Allopora boreopacifica* (Broch): Okhotsk Sea form, station 5016. Figure 9 is one of the larger systems. The smallest are about half this diameter, and may have one, two, or three dactylotomes only.



ALLOPORA CAMPYLECA

FOR EXPLANATION OF PLATE SEE PAGE 548



ALLOPORA POLYORCHIS (1) AND STYLASTER CANCELLATUS (2)

FOR EXPLANATION OF PLATE SEE PAGE 548



*ALLOPORA CAMPYLECA*

FOR EXPLANATION OF PLATE SEE PAGE 548



ALLOPORA POLYORCHIS

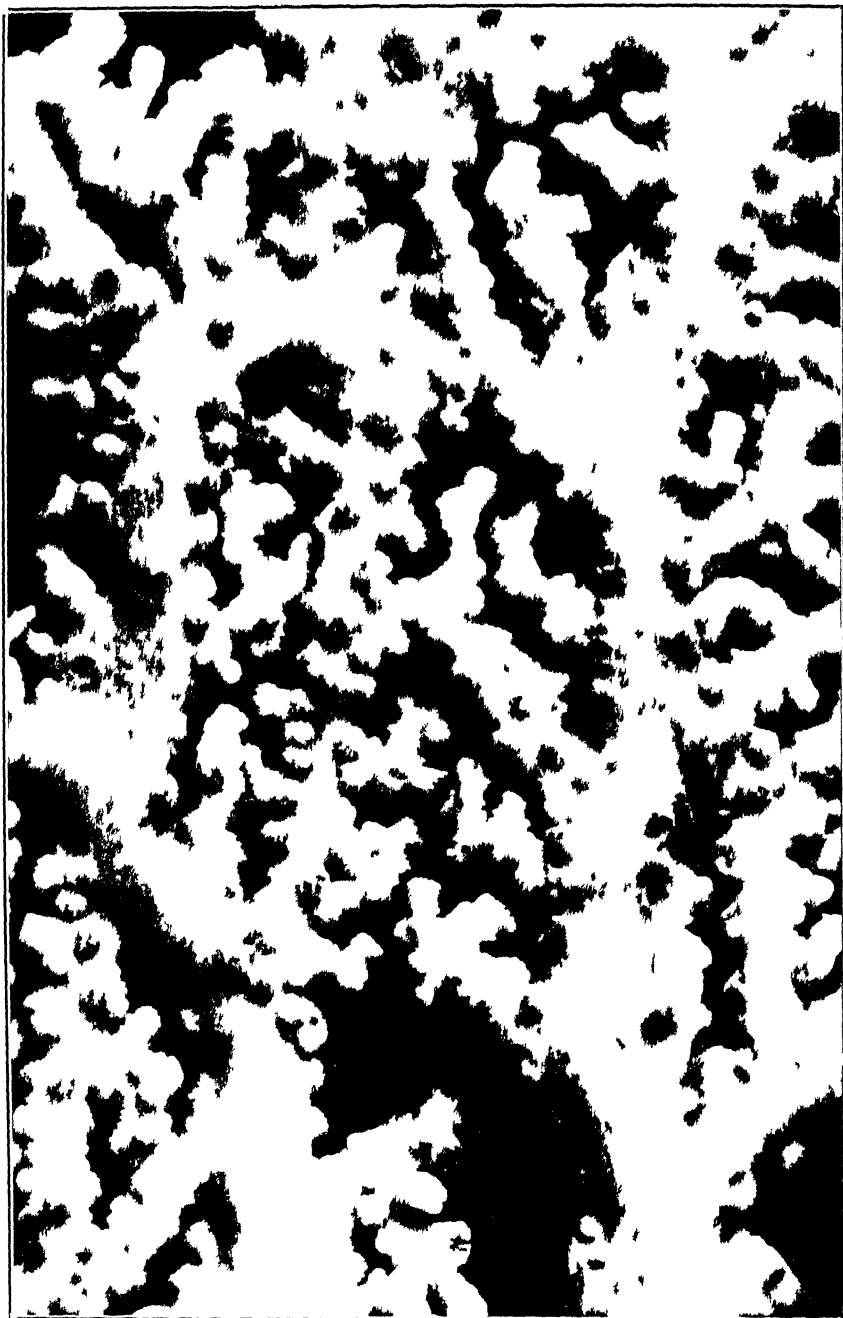
FOR EXPLANATION OF PLATE SEE PAGE 2



*ALLOPORA POLYORCHIS*

FOR EXPLANATION OF PLATE SEE PAGE 519





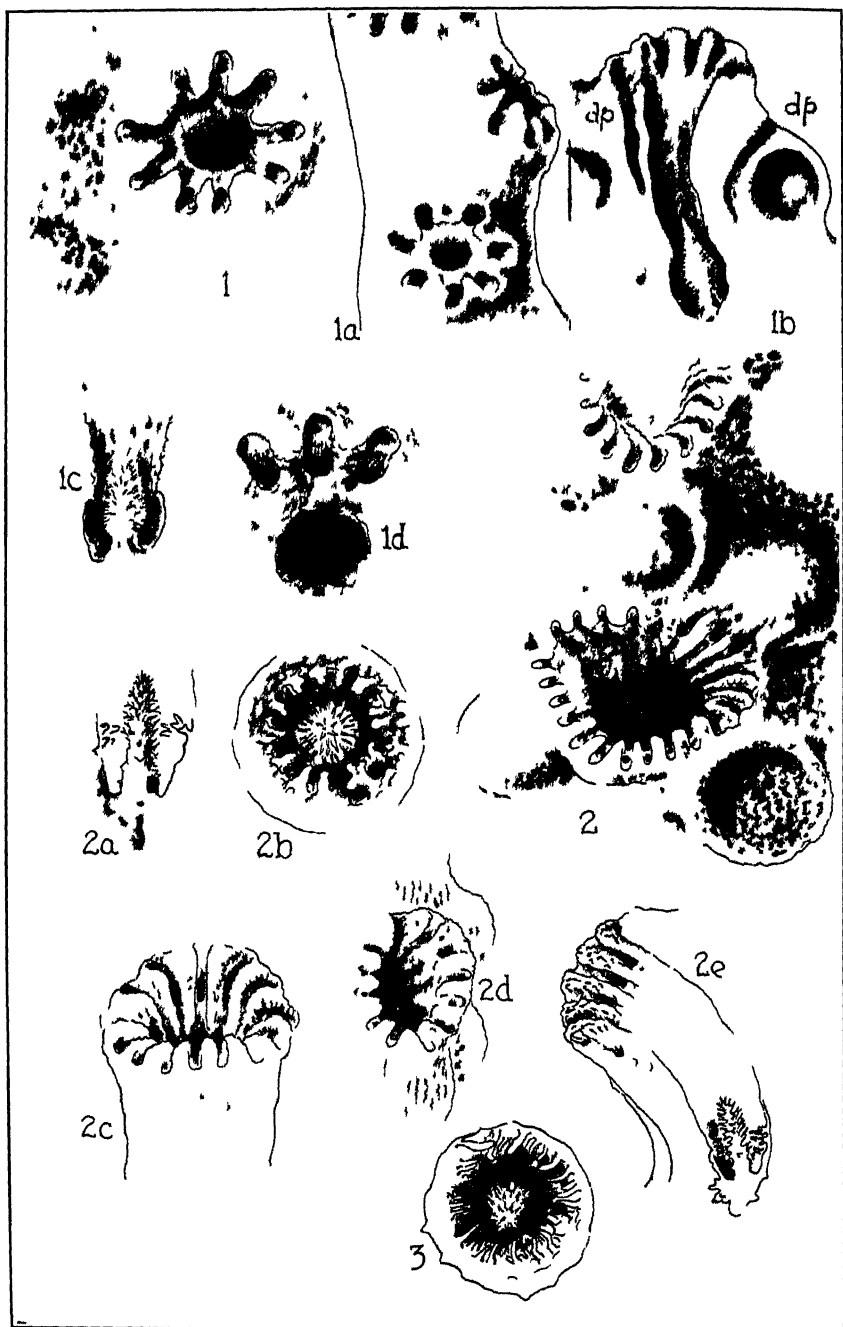
STYLASTER CANCELLATUS

FOR EXPLANATION OF PLATE SEE PAGE 519



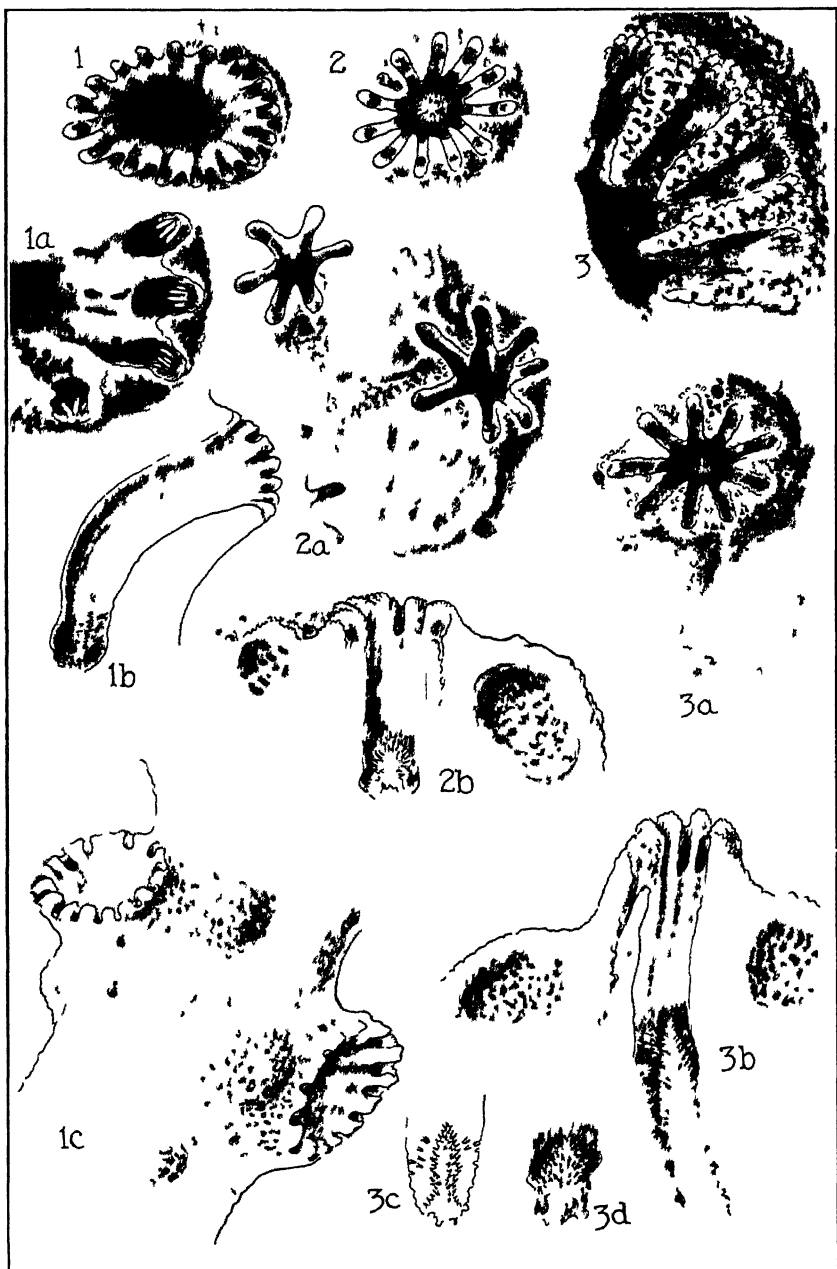
STYLAETER CANCELLATUS

FOR EXPLANATION OF PLATE SEE PAGE 49



ALLOPORA CAMPYLECA PARAGEA (1) A. C. TYLOA (2) AND STYLASTER ELASSOTOMUS (3)

FOR EXPLANATION OF PLATE SEE PAGE 549



STYLASTER ELASSOTOMUS (1) ALLOPORA STEJNEGERI (2) AND A. BROCHI (3)

FOR EXPLANATION OF PLATE SEE PAGES 549-550



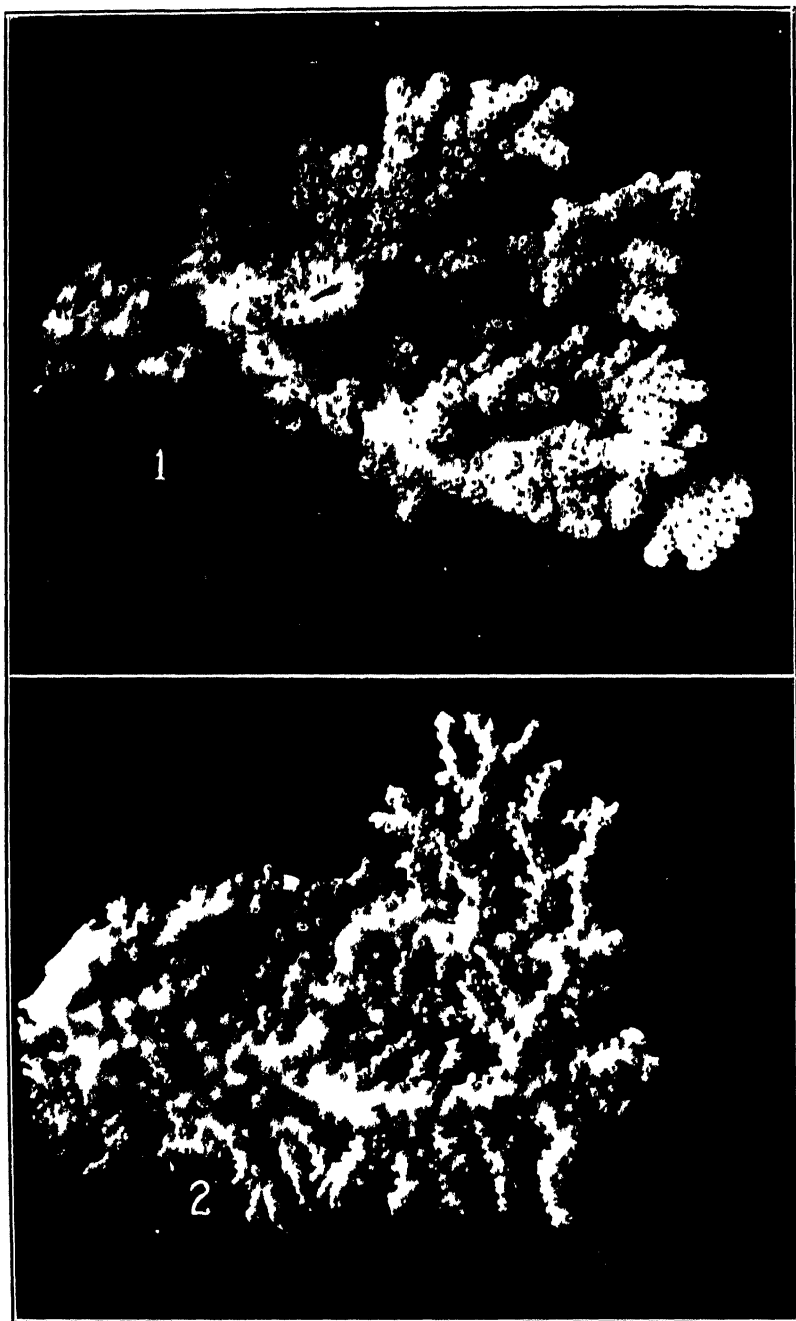
*ALLOPORA CAMPYLECA PARAGEA*

FOR EXPLANATION OF PLATE SEE PAGE 53



*ALLOPORA BROCHI*

FOR EXPLANATION OF PLATE SEE PAGE 550



ALLOPORA BROCHI (1) AND A CAMPYLECA TRACHYSTOMA (2).

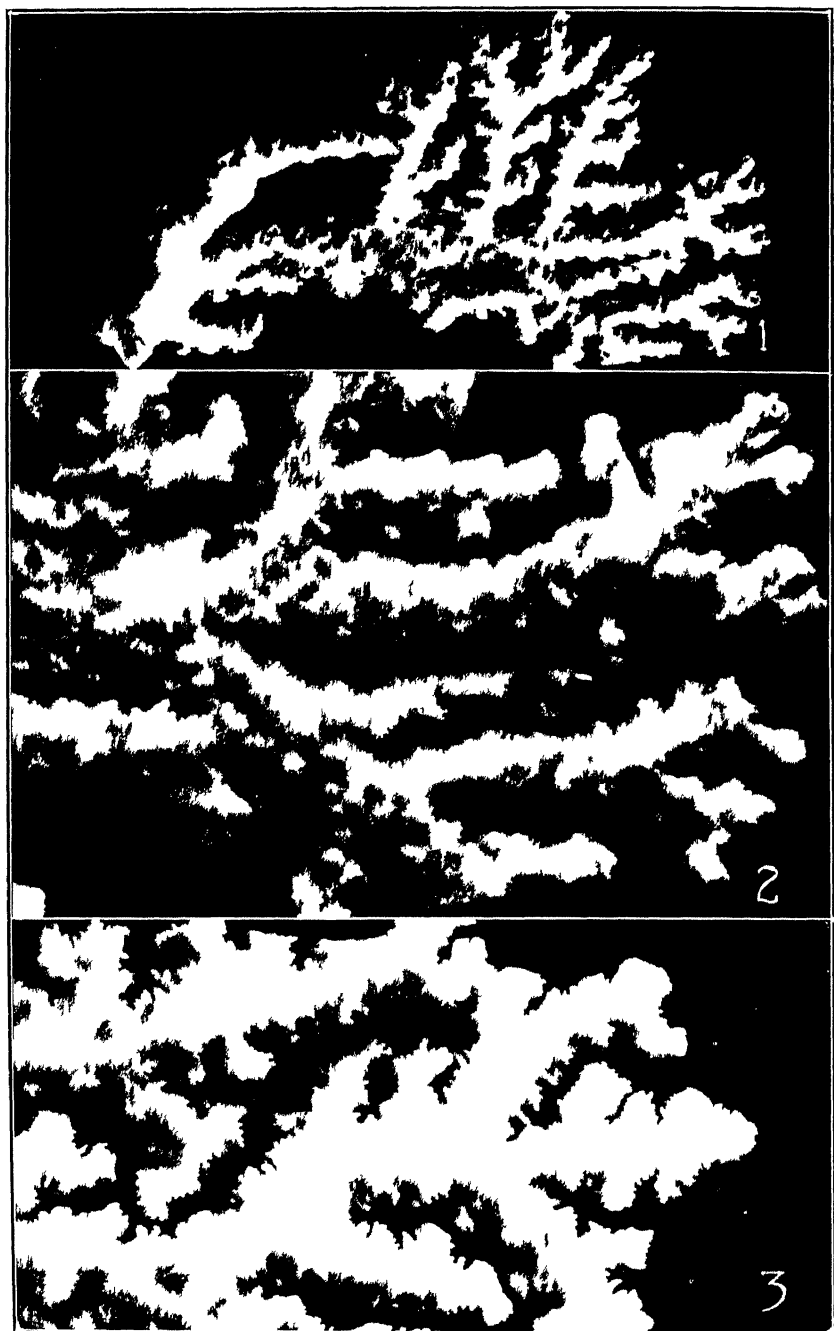
FOR EXPLANATION OF PLATE SEE PAGE 550



*ALLOPORA CAMPYLECA TRACHYSTOMA*

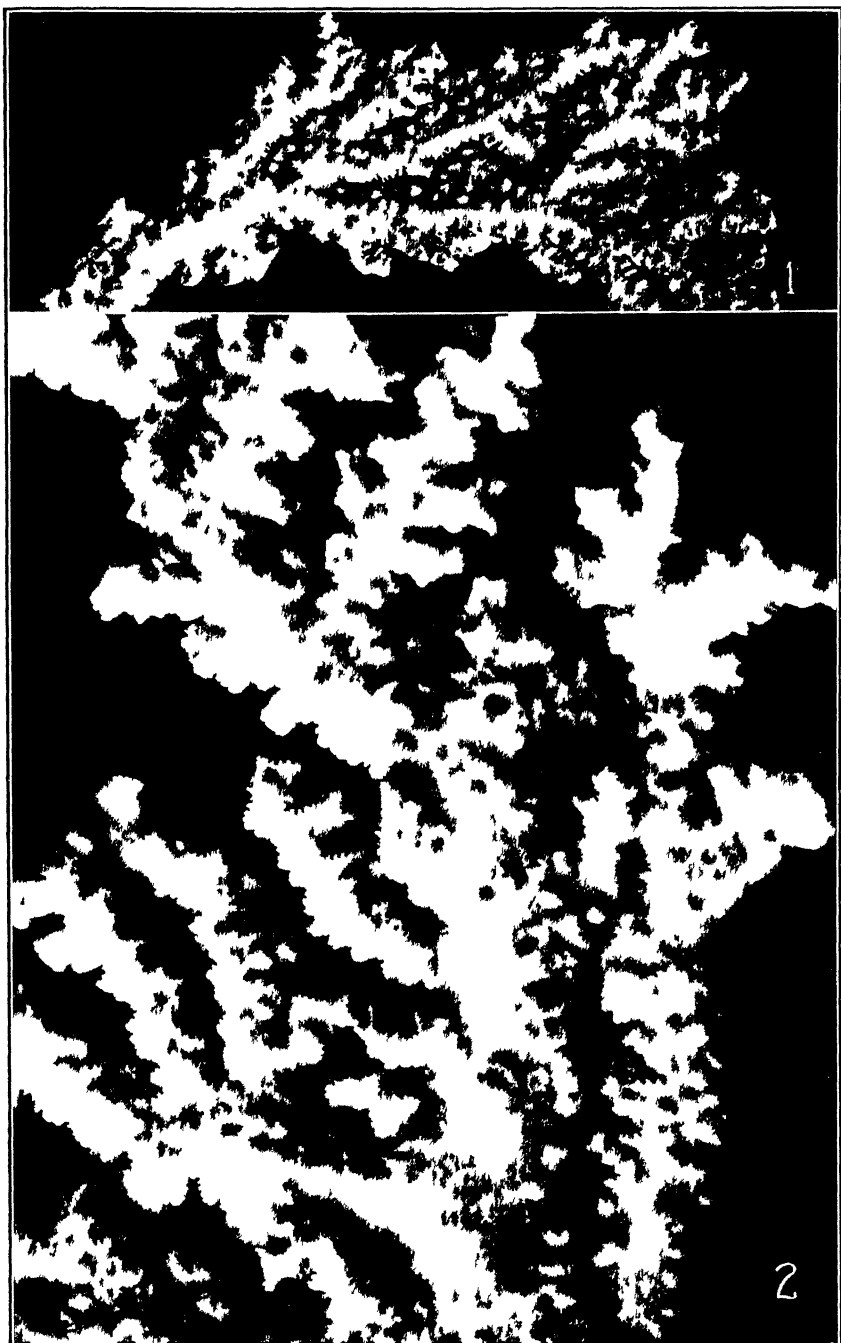
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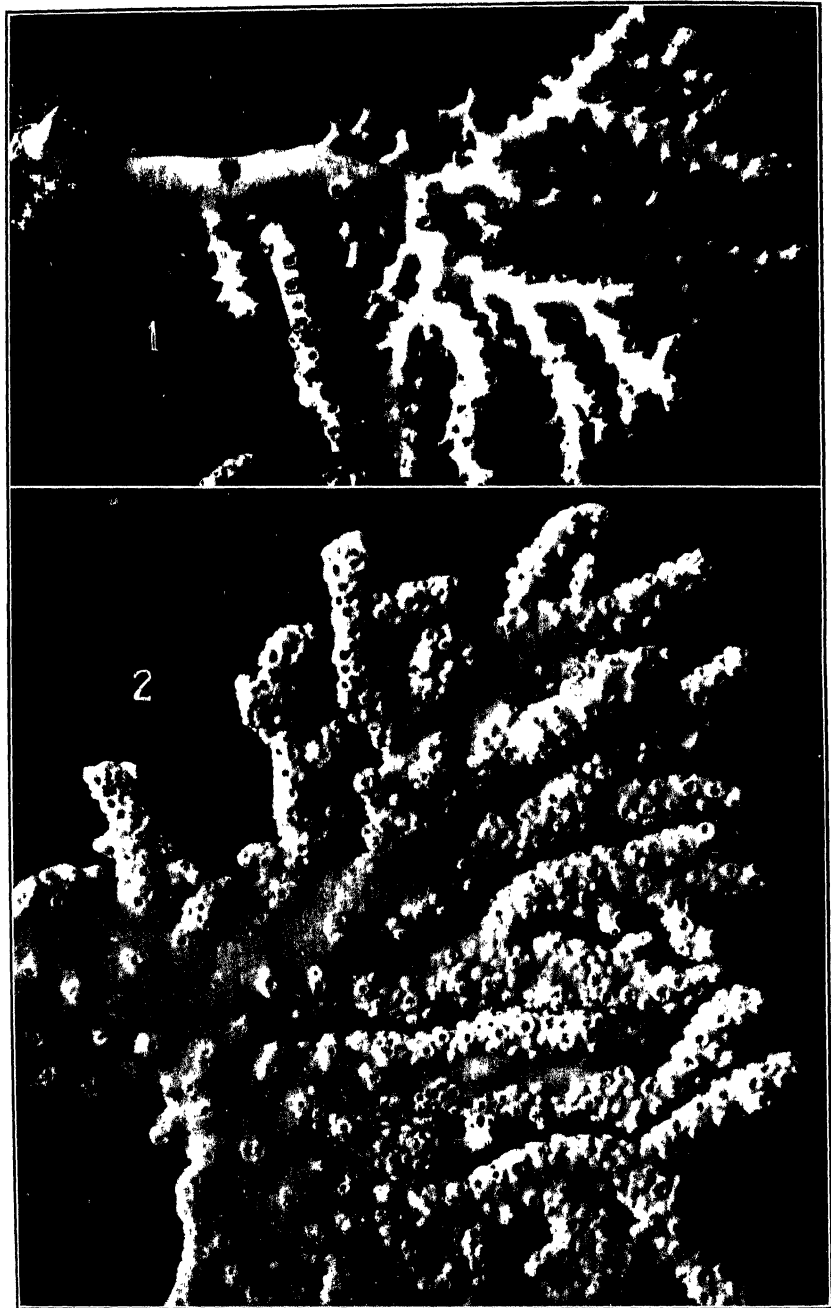
STYLASTER GEMMASCENS ALASKANUS

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STYLASTER GEMMASCENS ALASKANUS

FOR EXPLANATION OF PLATE SEE PAGE 550



STYLASTER ELASSOTOMUS (1) AND ALLOPORA MOSELEYANA (2).

FOR EXPLANATION OF PLATE SEE PAGE 550.



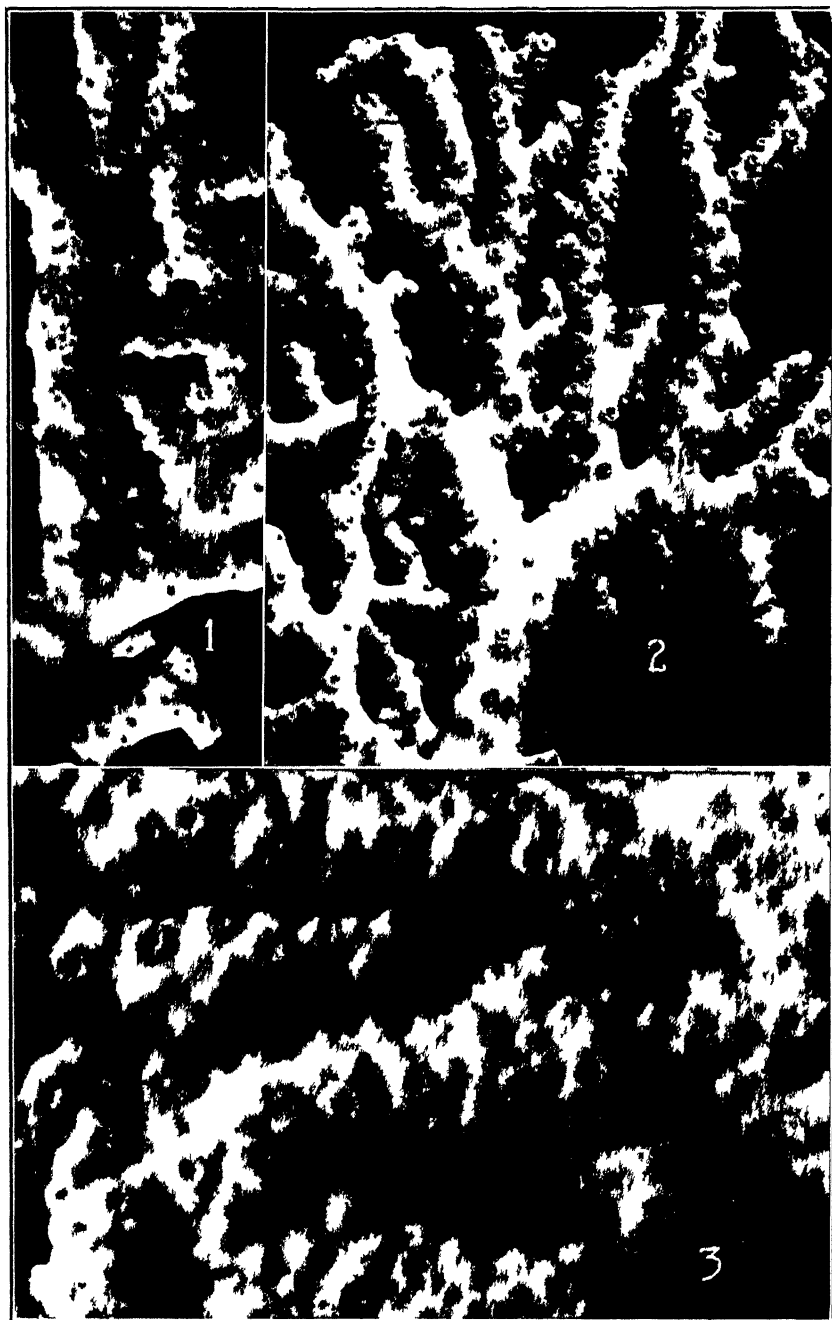
ALLOPORA MOSELEYANA.

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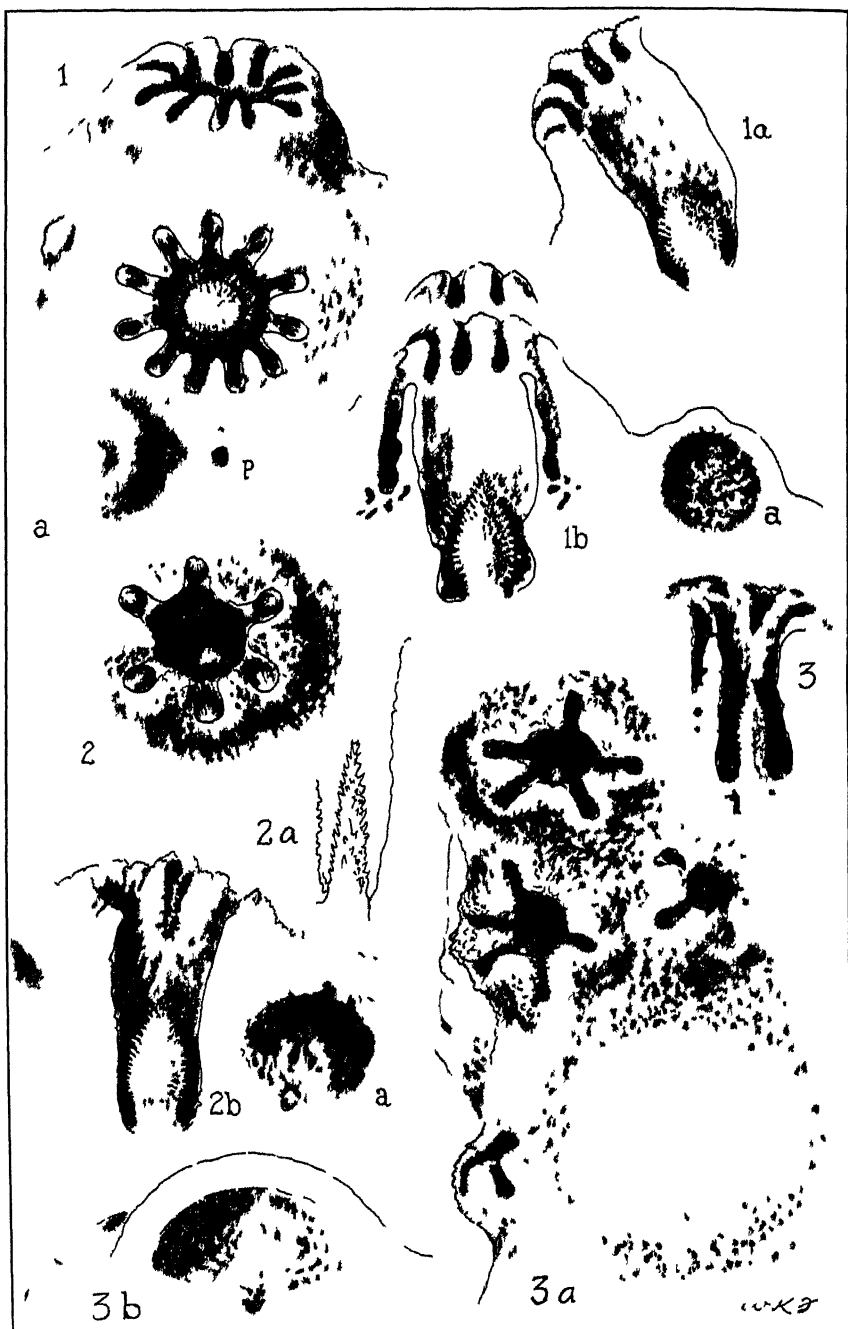
*ALLOPORA MOSELEYANA.*

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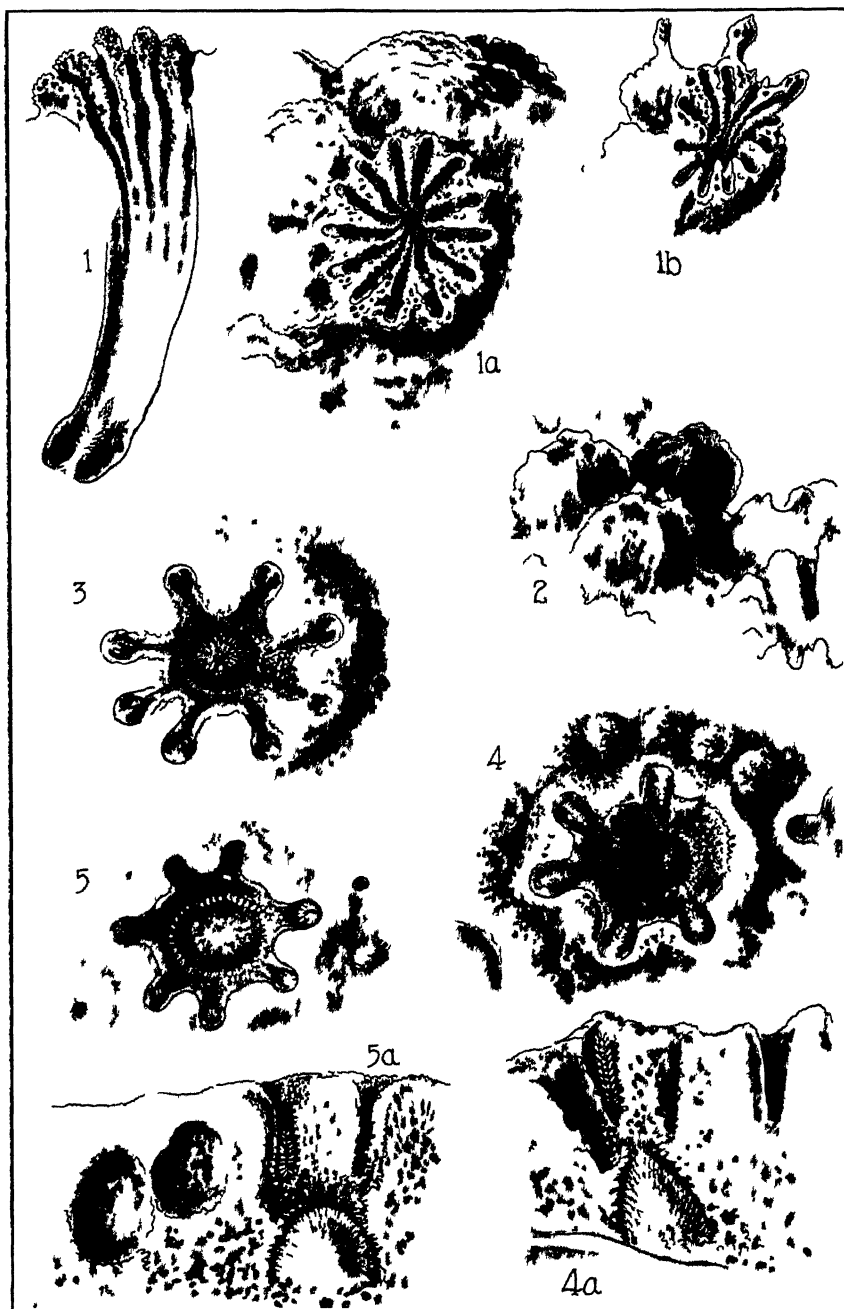
*ALLOPORA MOSELEYANA* FORMA *LEPTOSTYLA*

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ALLOPORA MOSELEYANA (1) A. NORVEGICA PACIFICA (2) AND  
A. BOREOPACIFICA (3)

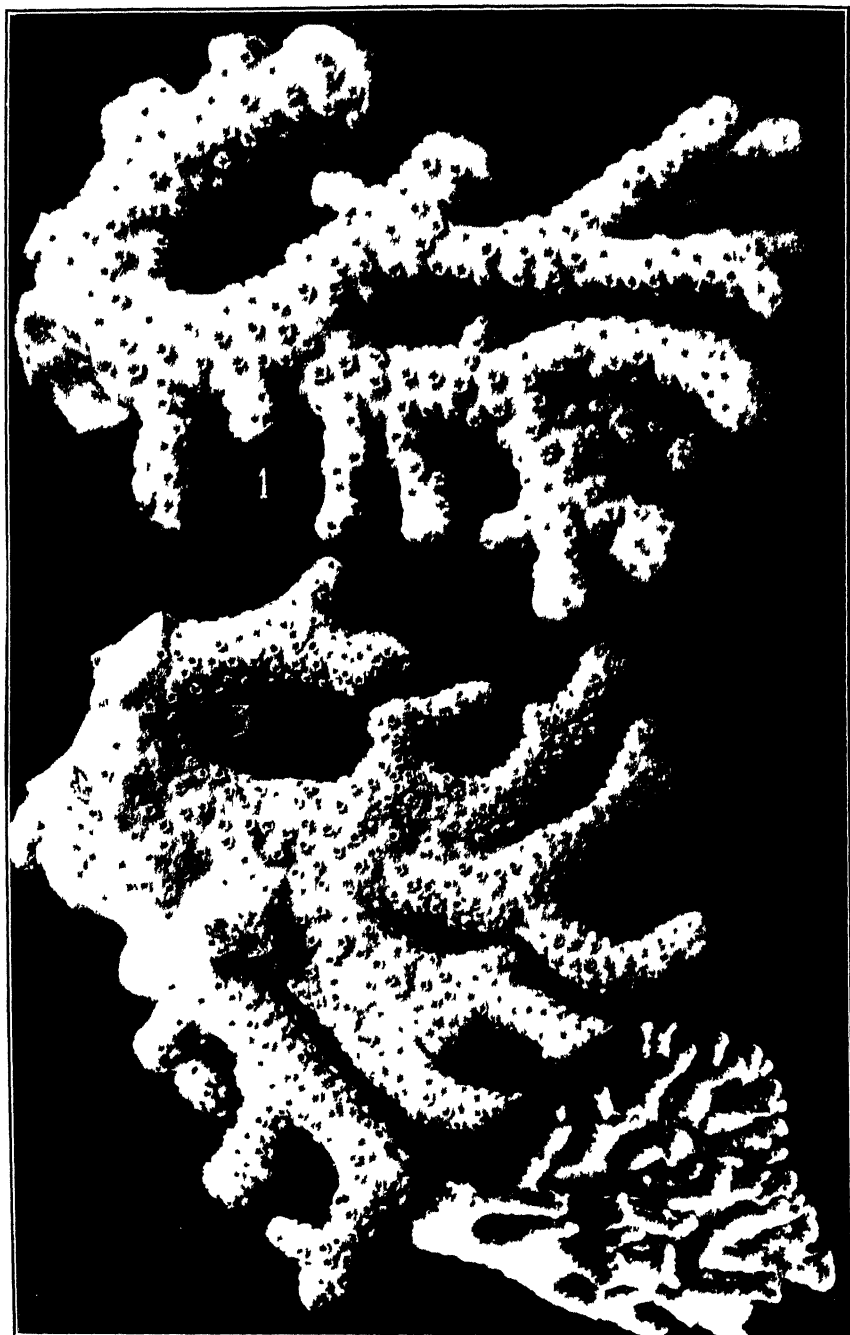
FOR EXPLANATION OF PLATE SEE PAGES 11-13



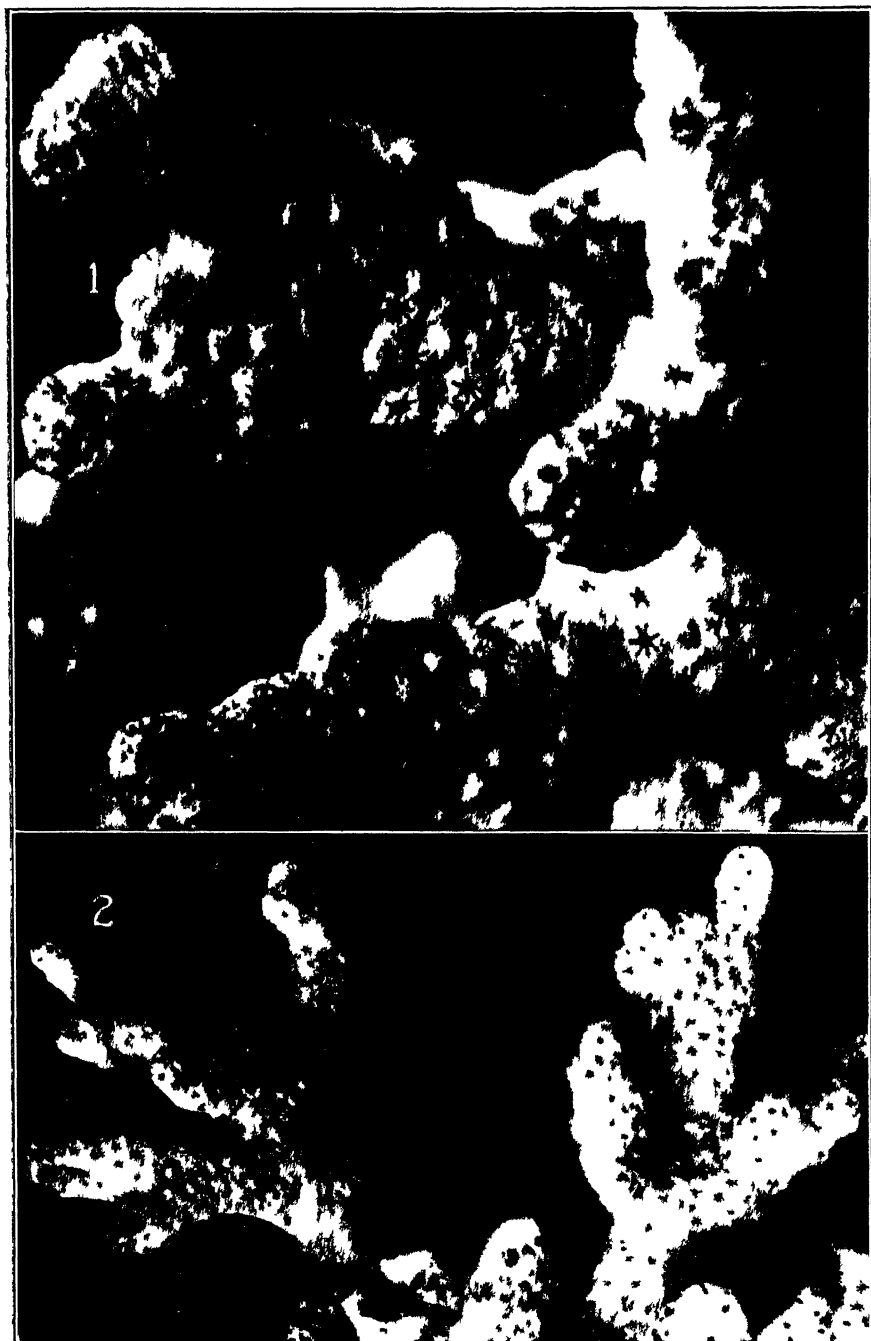
ALLOPORA CAMPYLECA TRACHYSTOMA (1) STYLASTER GEMMASCENS ALASKANUS  
(2) ALLOPORA VERRILLI (3) A. PAPILLOSA (4) AND A. PETROGRAPTA (5)

FOR EXPLANATION OF PLATE SEE PAGE 551



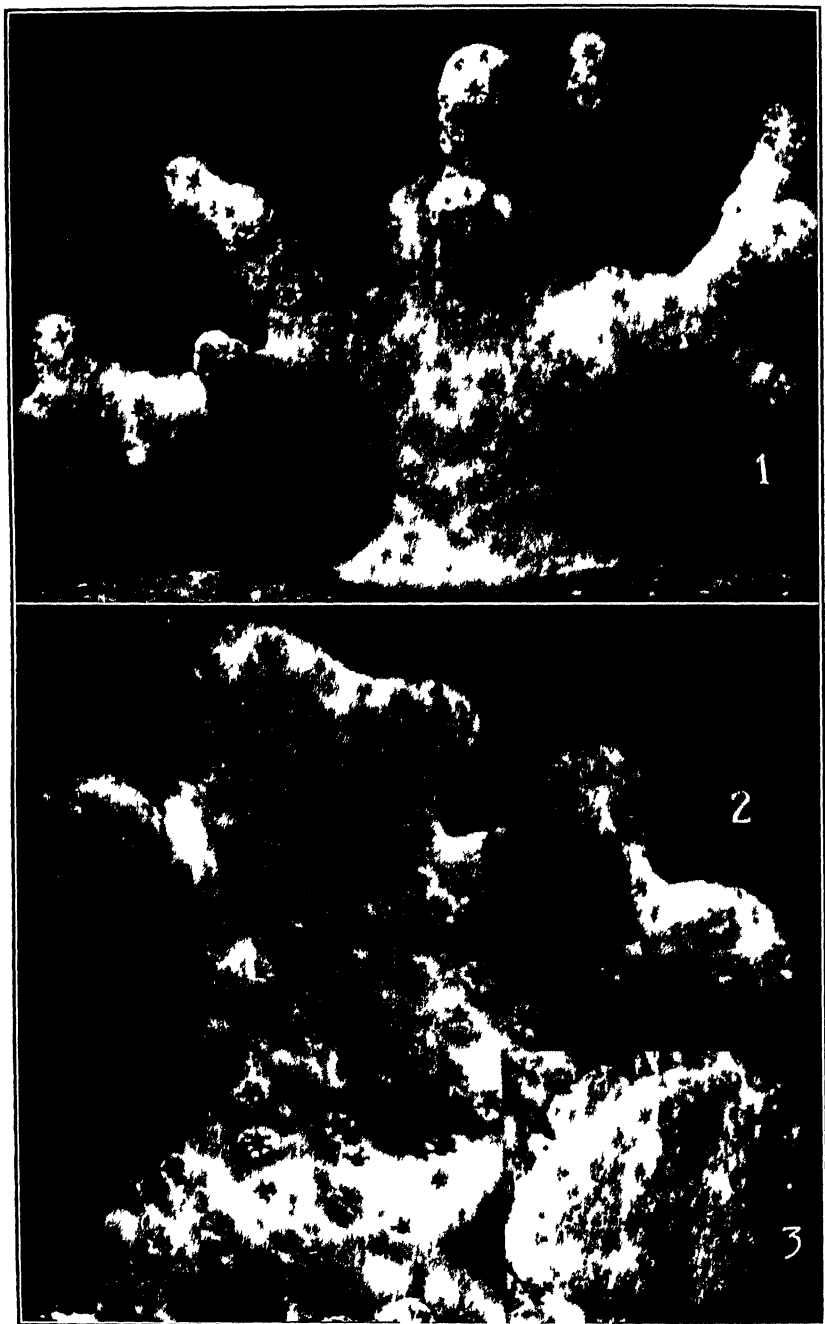


ALLOPORA NORVEGICA PACIFICA (1) A BOREOPACIFICA (2) AND A VENUSTA (3)  
FOR EXPLANATION OF PLATE SEE PAGE 551



*ALLOPORA STEJNEGERI*

FOR EXPLANATION OF PLATE SEE PAG



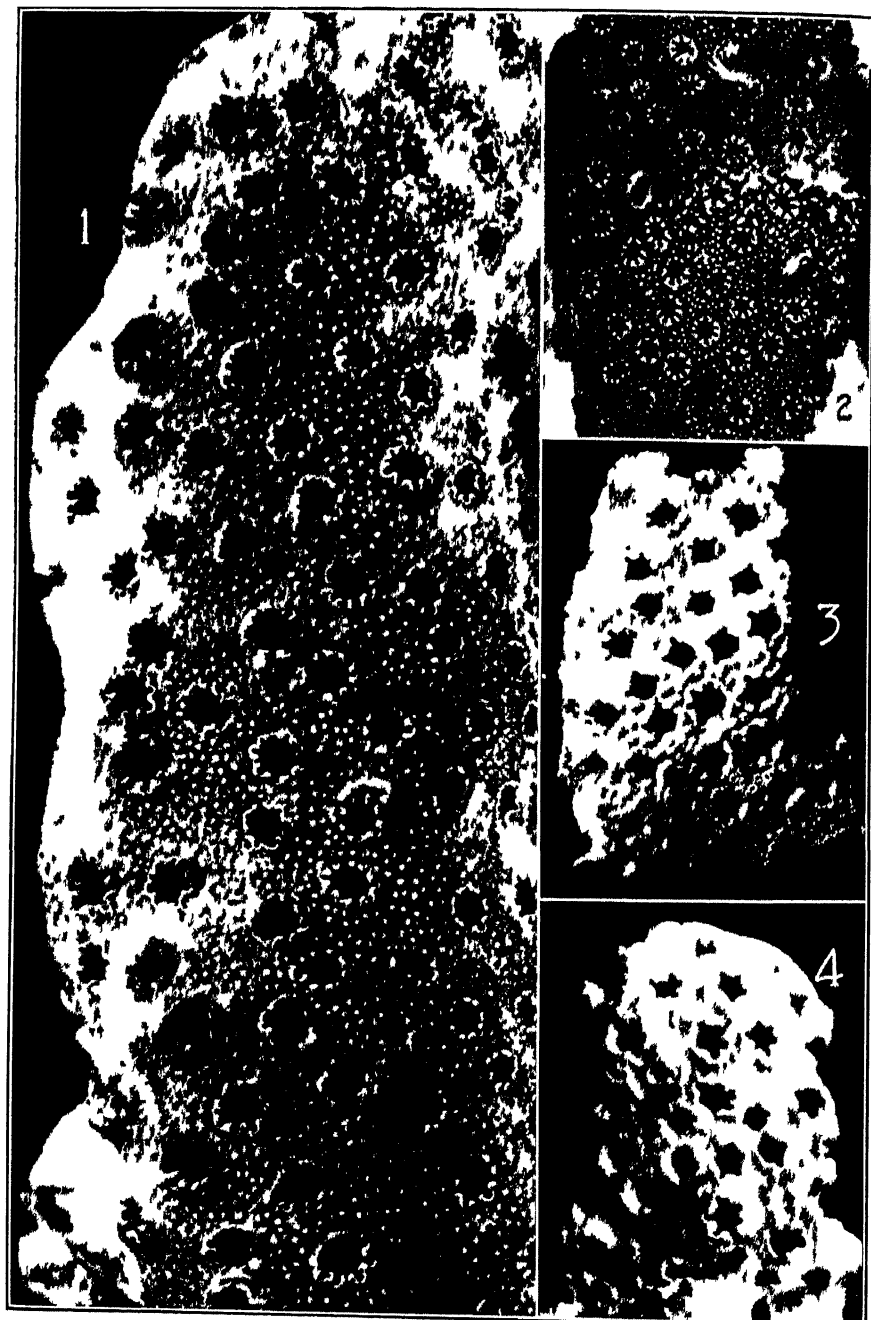
ALLOPORA VERRILLI

FOR EXPLANATION OF PLATE SEE PAGE 51



*ALLOPORA CALIFORNICA*

FOR EXPLANATION OF PLATE SEE PAGE 55



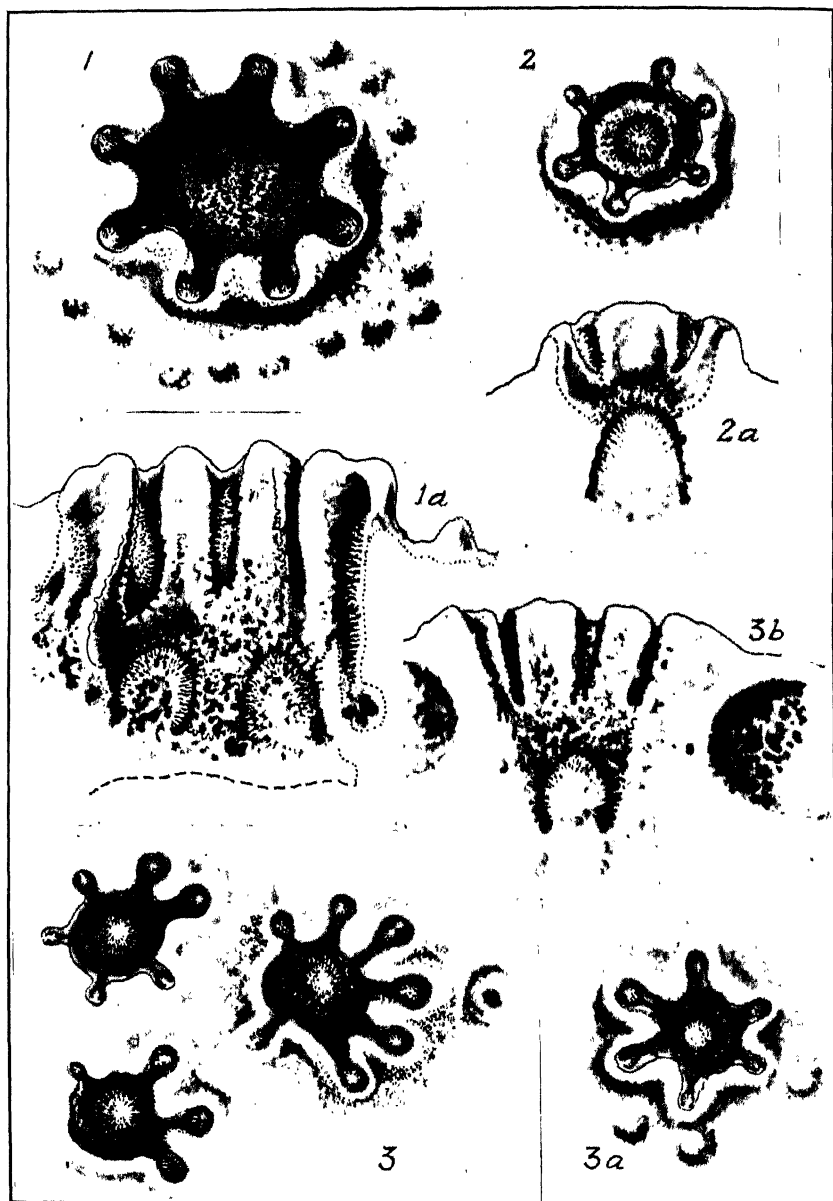
ALLOPORA PORPHYRA (1 2) A PAPILLOSA (3) AND A PETROGRAPTA (4)

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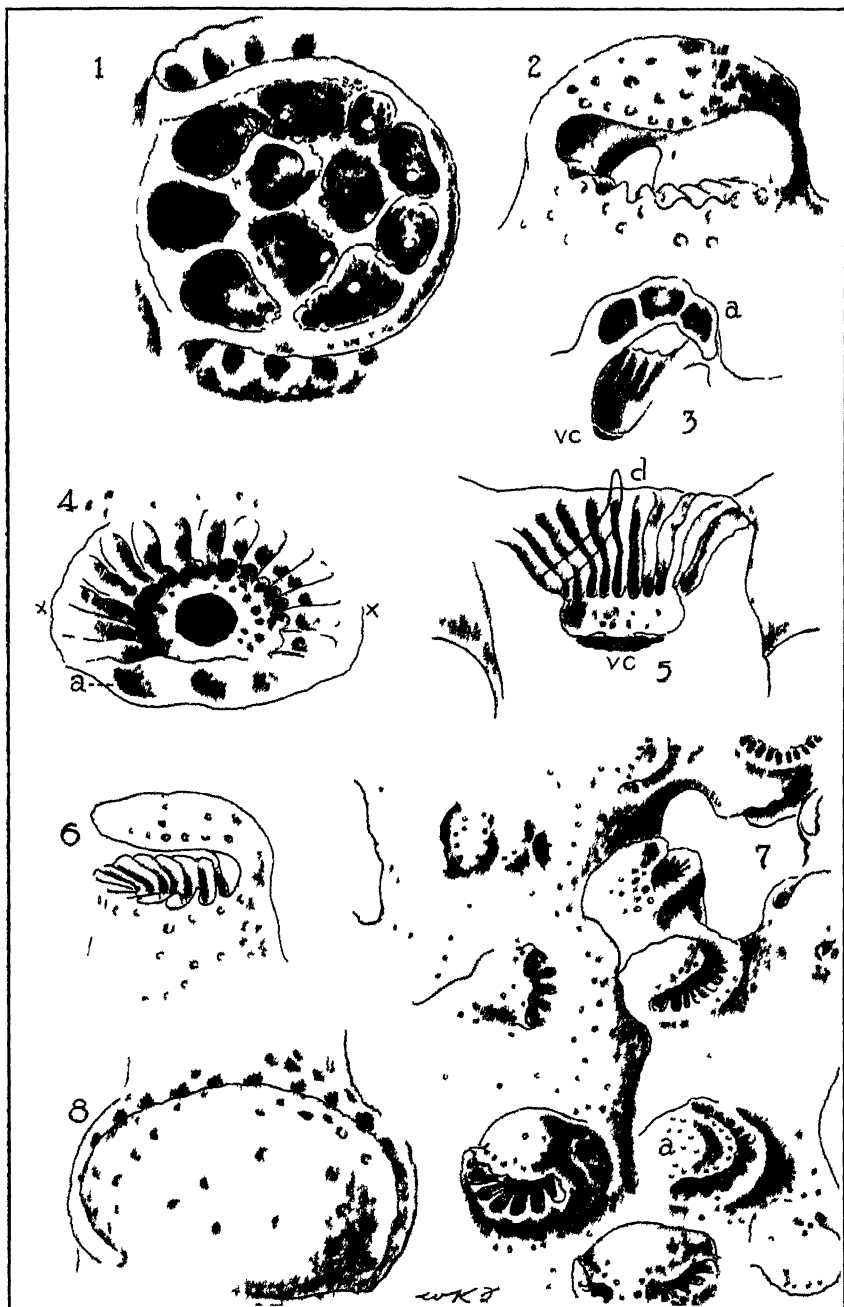
ALLOPORA PORPHYRA.

EXPLANATION OF PLATE SEE PAGE 552



ALLOPORA PORPHYRA (1), A. VENUSTA (2), AND A. CALIFORNICA (3).

FOR EXPLANATION OF PLATE SEE PAGE 552.



CRYPTOHELIA TROPHOSTEGA

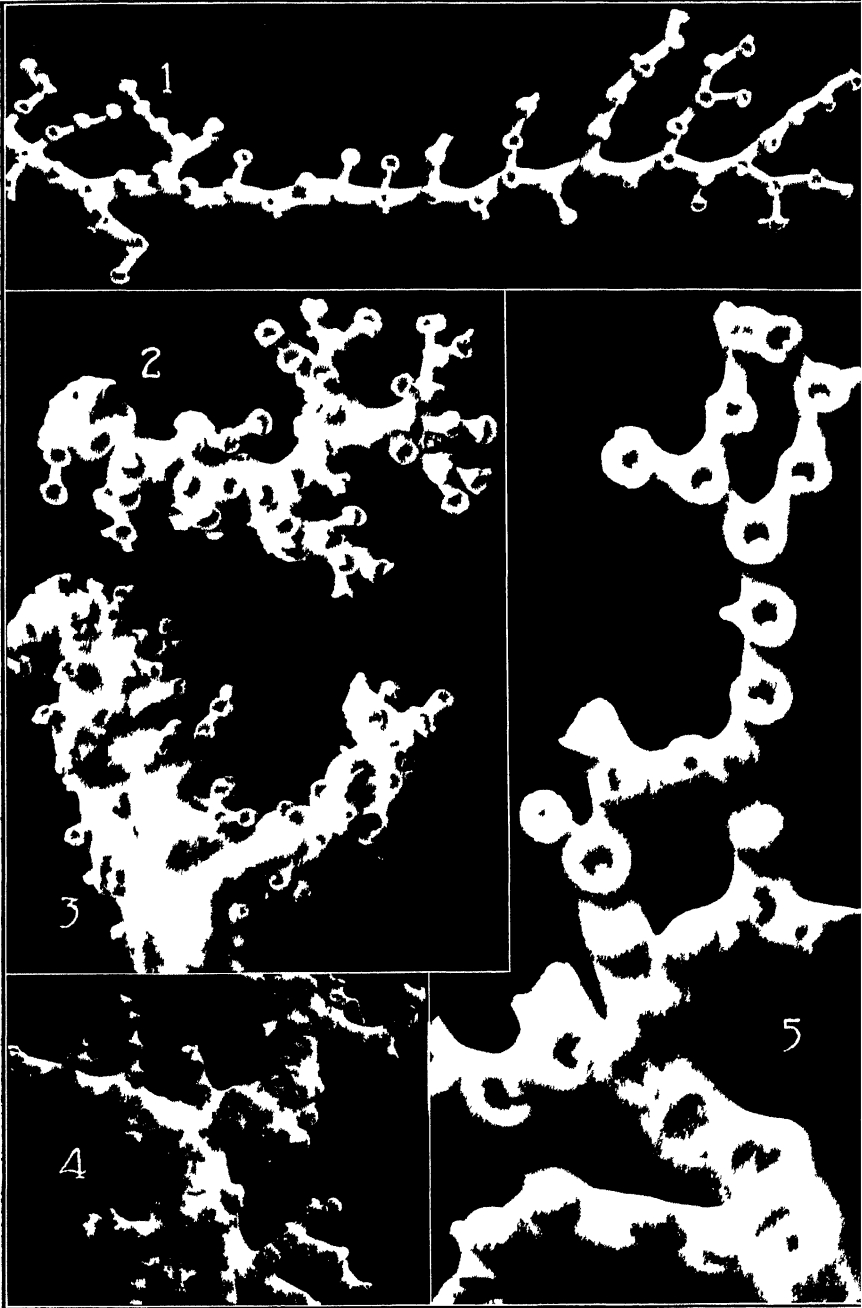
FOR EXPLANATION OF PLATE SEE PAGE 55





CRYPTOHELIA TROPHOSTEGA

FOR EXPLANATION OF PLATE SLIP PAGE 55



CRYPTOHELIA PUDICA (1) C. JAPONICA (2-4) AND C. GIGANTEA (5)

FOR EXPLANATION OF PLATE SEE PAGE 552



ERRINOPORA STYLIFERA (1) AND E. POURTALESII (2)

FOR EXPLANATION OF PLATE SEE PAGE 3



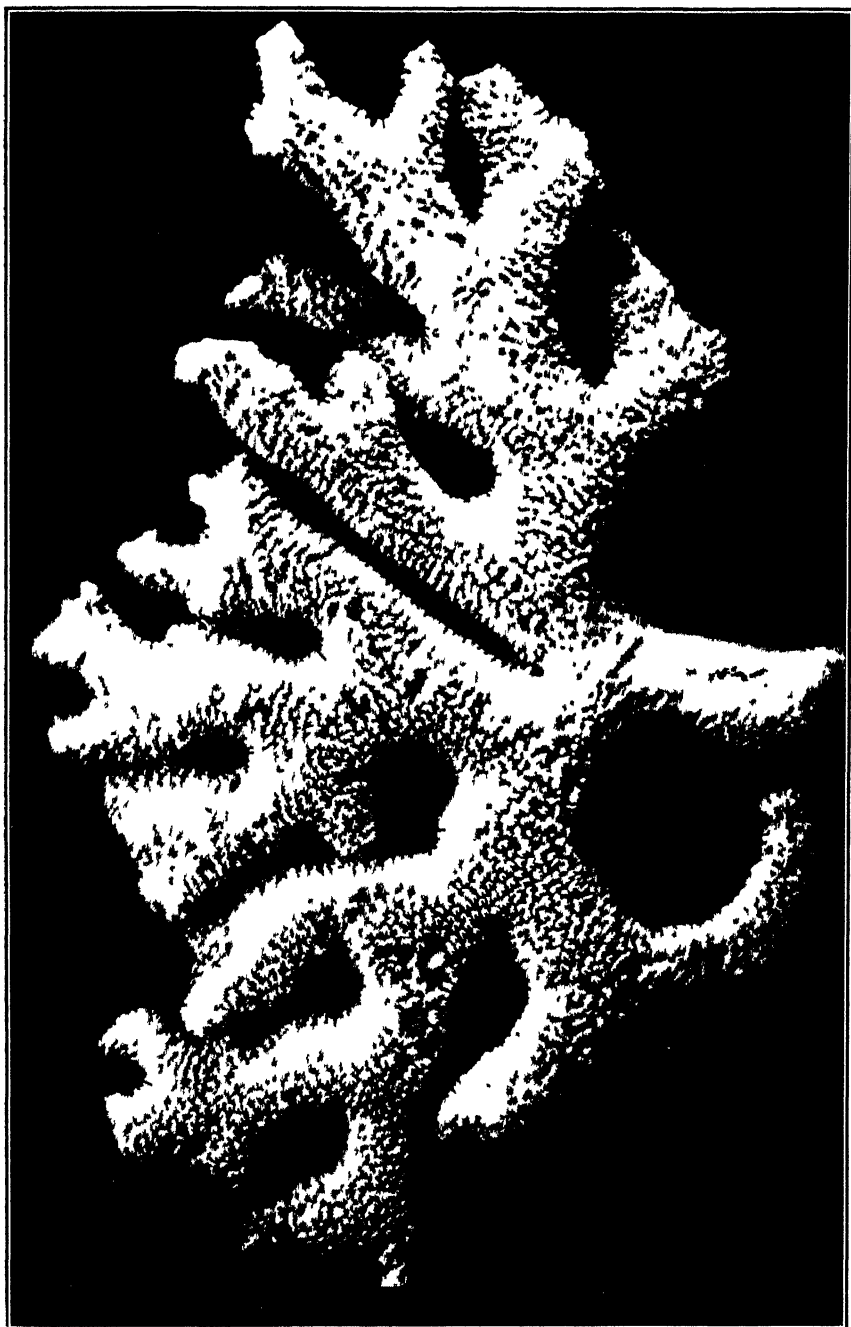
ERRINOPORA NANNECA (1) AND E. POURTALESII (2)

FOR EXPLANATION OF PLATE SEE PAGE 553



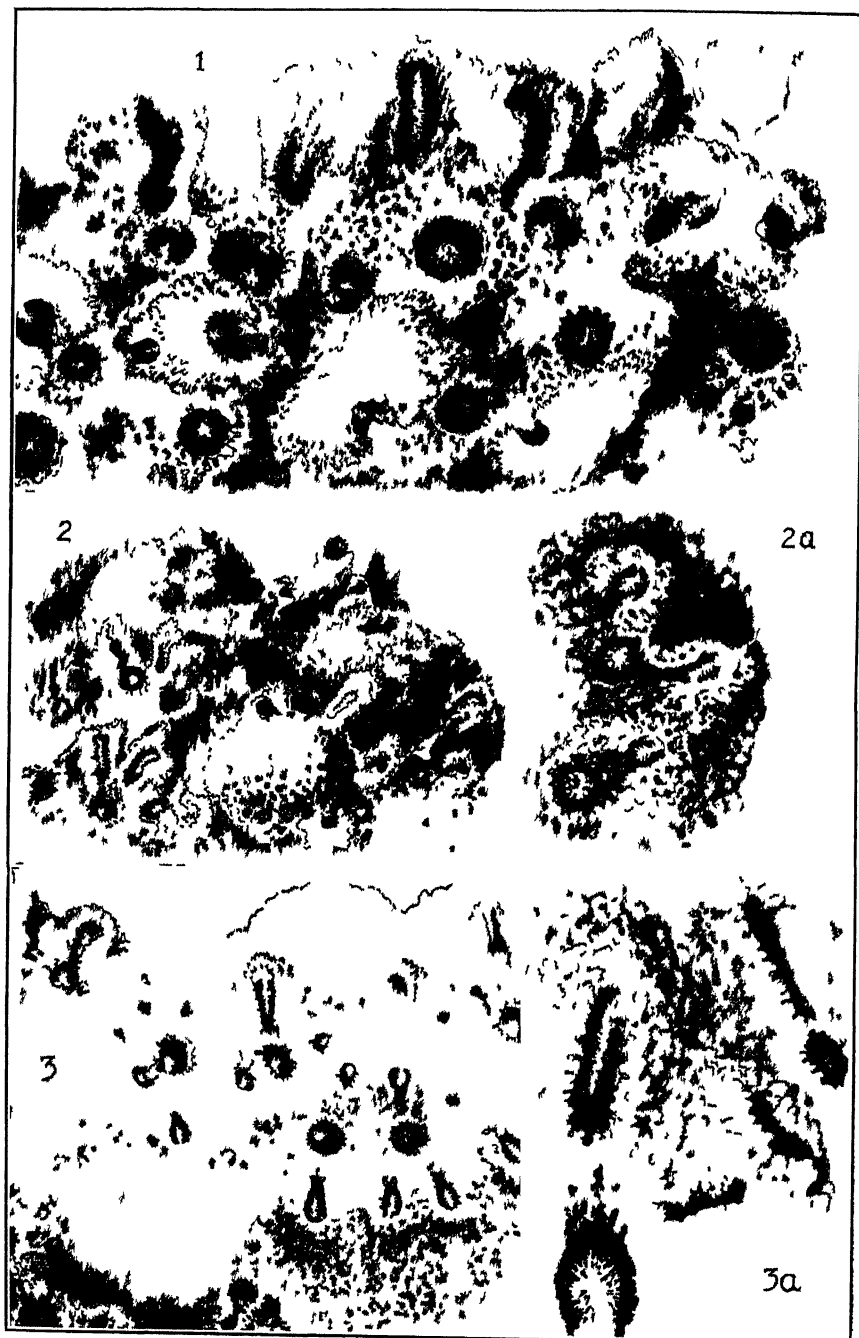
*ERRINOPORA NANNECA.*

FOR EXPLANATION OF PLATE SEE PAGE 553.



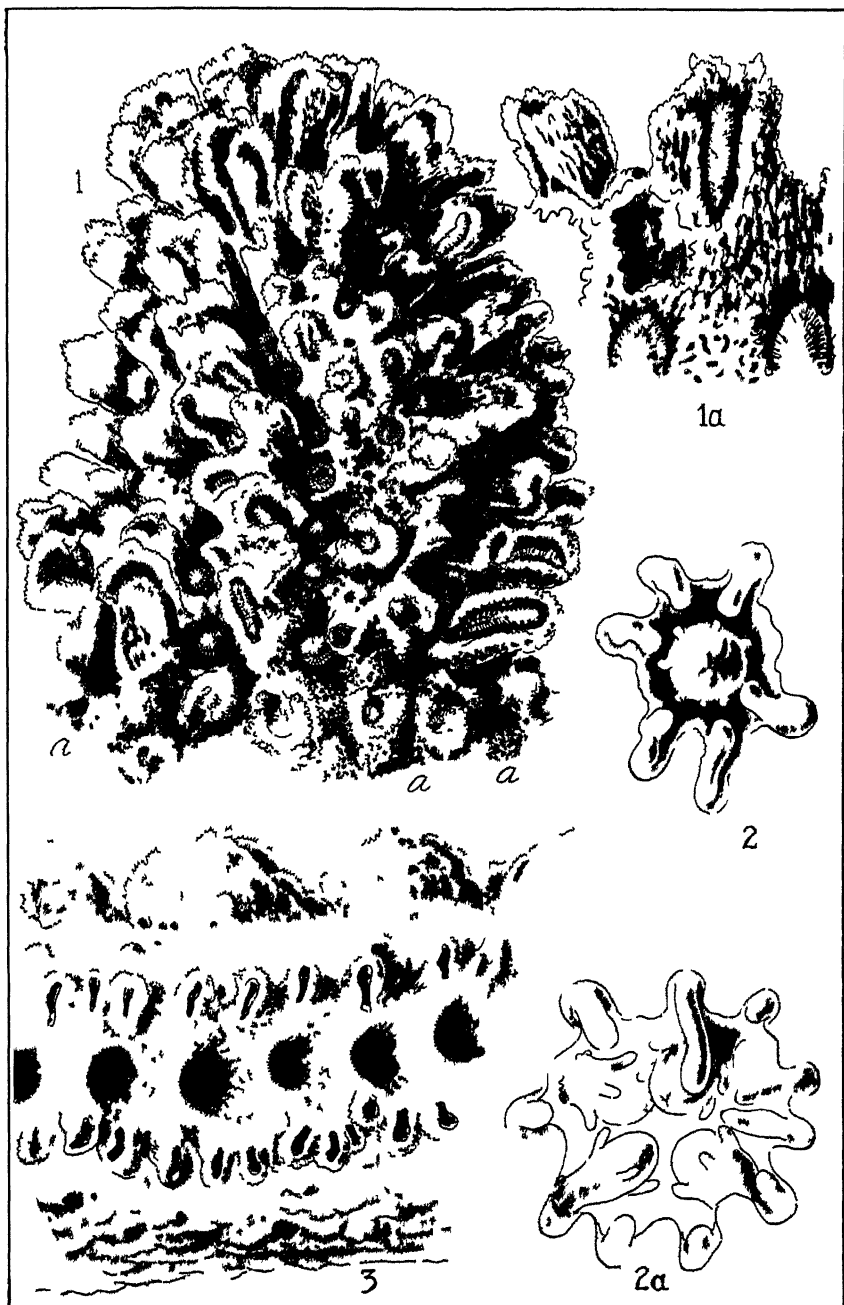
ERRINOPORA ZARHYNCHA

FOR EXPLANATION OF PLATE SEE PAGE 553



ERRINOPORA ZARHYNCHA (1), E NANNECA (2) AND E STYLIFERA (3).

FOR EXPLANATION OF PLATE SEE PAGE 553



ERRINOPORA POURTALESII (1) ALLOPORA PORPHYRA (2) AND DISTICHOPORA BOREALIS (3)

FOR EXPLANATION OF PLATE SEE PAGE 553





*DISTICHOPORA BOREALIS*

FOR EXPLANATION OF PLATE SEE PAGE 53



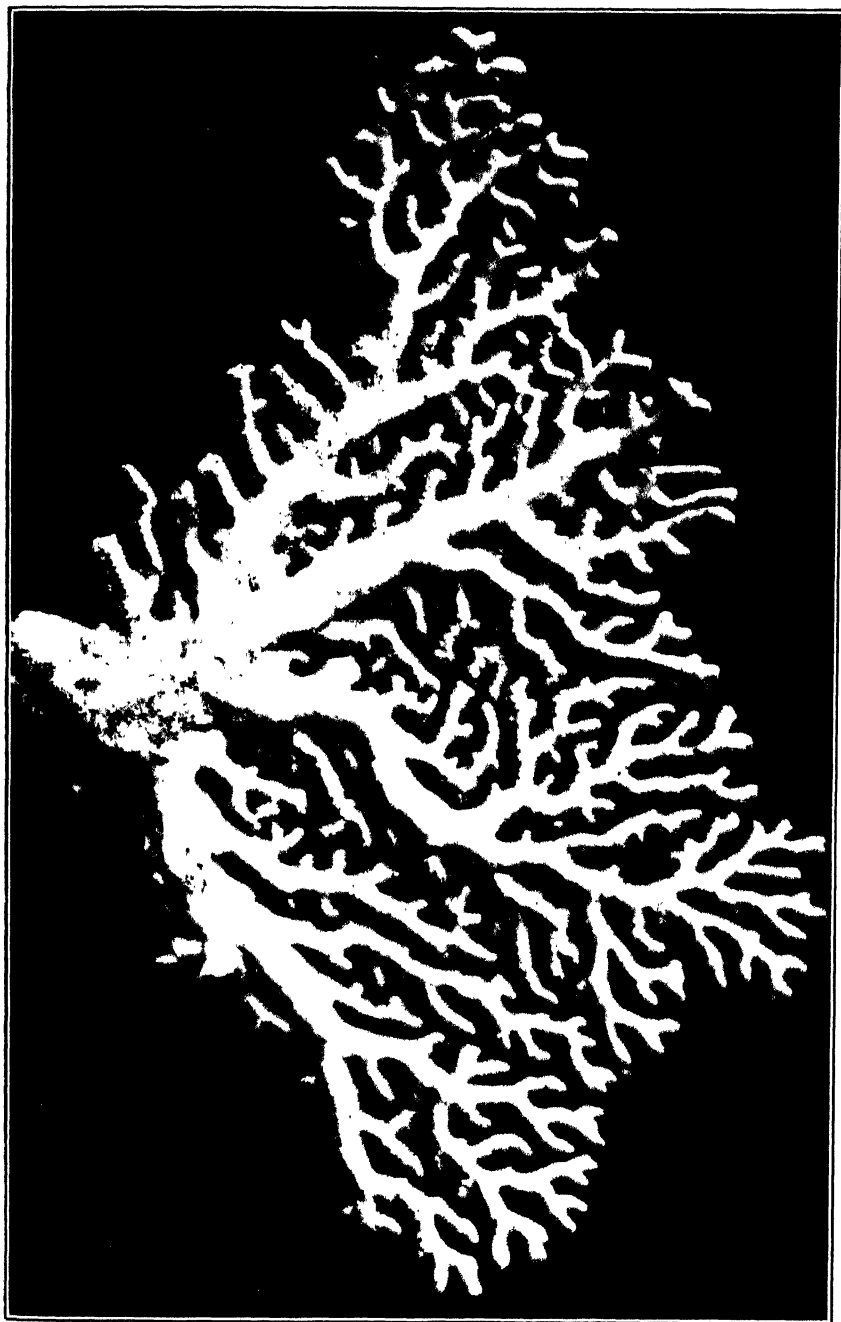
*DISTICHOPORA BOREALIS*

FOR EXPLANATION OF PLATE SEE PAGE 553



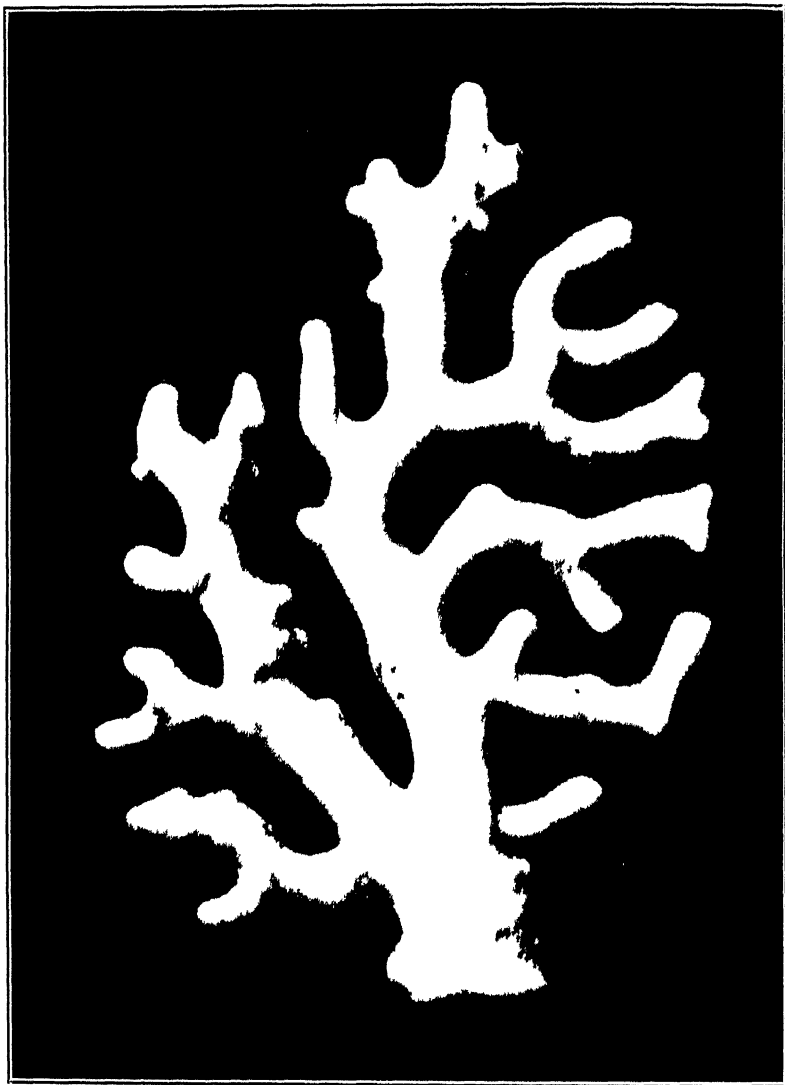
*DISTICHOPORA BOREALIS.*

FOR EXPLANATION OF PLATE SEE PAGE 553.



*DISTICHOPORA SULCATA.*

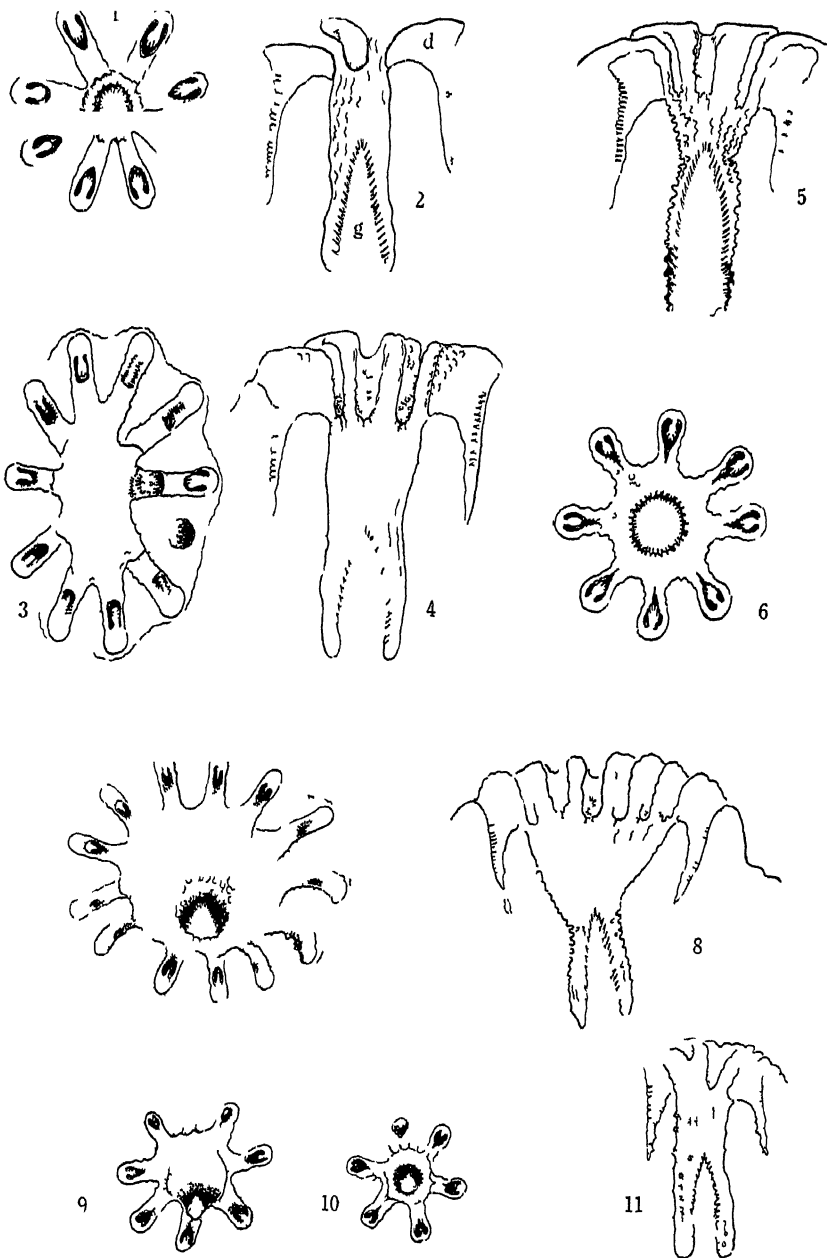
FOR EXPLANATION OF PLATE SEE PAGE 554.



*DISTICHOPORA GRACILIS*

FOR EXPLANATION OF PLATE SEE PAGE 174

←one millimeter→



ALLOPORA SOLIDA (1 2) A NORVEGICA PACIFICA (3 4) A VERRILLI (5 6)  
A SCABIOSA (7 8) AND A BOREOPACIFICA (9-11)

FOR EXPLANATION OF PLATE SEE PAGE 551



SMITHSONIAN INSTITUTION  
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A GIANT NEW SPECIES OF FAIRY SHRIMP OF THE  
GENUS *BRANCHINECTA* FROM THE STATE OF WASH-  
INGTON

BY JAMES E. LYNCH

*University of Washington, Seattle, Wash.*

IN THE spring of 1935, I was given two specimens of an exceptionally large and apparently undescribed species of *Branchinecta* by Dr. M. H. Hatch, of the Department of Zoology of the University of Washington. The honor of discovering this giant phyllopod belongs to J. F. Clark, then of Washington State College, who had collected the specimens in the vicinity of Coulee City, Wash., and from whom Dr. Hatch had received them. On May 3, 1936, I visited many of the temporary ponds between Coulee City and the Grand Coulee Dam, in one of which I found the giant *Branchinecta*. Eighty-nine specimens were obtained, of which 39 were males and 50 were females.

The measurements given herein were obtained from 10 mature specimens of each sex, selected to show the range in size of adults. The figures given are averages, with the range following in parentheses.

Genus *BRANCHINECTA* Verrill*BRANCHINECTA GIGAS*, new species

## PLATES 77-80

*Specific diagnosis.*—Male: Total length from front to end of cercopods 63 (61-70) mm. Length of combined head and thorax somewhat less than that of combined genital segments and abdomen. Antennule 5.6 (4.2-7.0) mm in length, terminated by a group of about 30 small sensory hairs. Antenna 12.6 (11-15) mm in length,



of two articles. Proximal article cylindrical, slightly constricted near the middle, 7.5 (6.5–9.0) mm in length. Terminal article blunt, somewhat flattened and slightly curved inward, and twisted in such a way that the broader diameter at the tip is at right angles to the corresponding transverse axis at proximal end of the article. Length of terminal article 5.2 (4.5–6.0) mm. Both articles of antenna devoid of processes, tubercles, or denticulations, although both present considerable areas granulous with microscopic papillae. Compound eyes small; peduncles 1.0–1.6 mm long; oval corneal portion 0.60–0.71 mm in the longer (anteroposterior) axis. Median ocellus present. Labrum truncated, bearing a blunt nasiform process. Median border of endopodite bears heavily chitinized hooked spines, with a triangular area of denticles on dorsolateral side. Everted penes bear a spur near the base and two spinose lobes near distal end. Cercopods 13.5 (10.3–16.3) mm in length, diverging, with a row of plumose setae extending most of the length of cercopod on ventrolateral side; similar, but longer, setae occurring dorsally and medially in distal half only.

Female: Total length from front to end of cercopods 86 (69–97) mm. Antennule 5.5 (3.8–6.8) mm in length. Antenna 12.6 (7.8–15) mm in length. Antenna of female composed of one article, tapering gradually to a sharp point. Three-fourths of distance from cephalic end to apex of antenna there is a slight swelling, distally to which antenna presents a feeble sigmoid curve. Ovisac piriform, 11 (7–13) mm in length, 6.2 (4.5–7.5) mm in transverse diameter at base, and carrying 200 to 600 eggs. Females exceed males in all dimensions except for lengths of antennules and antennae and diameter of eye (diameter of cornea slightly smaller than that of male). Average ratio of length of males to that of females is 1:1.36. Cercopods 18.6 (12.5–22.5) mm in length.

*Locality*.—Temporary alkali ponds in the Upper Grand Coulee, 19 miles north of Coulee City, Grant County, Wash.

*Type specimens*.—Holotype (U.S.N.M. no. 72572) and paratypes have been deposited in the United States National Museum.

*Description*.—The color of living specimens was a translucent white, with a mere suggestion of a bluish cast. The intestine in freshly collected specimens was bright red, caused by a diet of red *Diaptomus* sp. The ovaries were pale blue; eggs, when first discharged into the ovisac, pale blue-green, turning yellow before being laid. Cement glands in the ovisac were dark yellow to light brown.

Both articles of the clasping antenna of the male are provided with microscopic papillae, which are likely to be overlooked when the animals are studied with low magnifications. The inner and anterior sides of the terminal half of the distal article are covered with small,

closely set papillae, flat on top, which give the area they cover a tessellated appearance (pl. 80, figs. 5, 6). The papillae are  $8\mu$  to  $9\mu$  high,  $20\mu$  to  $30\mu$  in diameter, and are separated by spaces  $2\mu$  to  $6\mu$  wide. The flat upper surfaces of the papillae have a distinct overhang toward the proximal end of the antenna. In end view the flat surfaces appear to be pitted with minute pores, which, however, are probably spaces beneath the surface of the papillae.

The anterior and lateral sides of the distal fourth of the basal article of the antenna are covered with closely set papillae of hemispherical shape, mostly  $7\mu$  to  $15\mu$  in diameter and  $1\mu$  to  $11\mu$  high. Scattered among them are pointed sensory hairs averaging  $80\mu$  in length. Toward the proximal end of the basal article these papillae are arranged as scattered and widely separated groups of circular outline,  $60\mu$  to  $200\mu$  in diameter, with a hair in the center of the group. Toward the periphery of such groups the papillae become lower and broader (pl. 78, fig. 3).

The uniarticulate antennae of the female are tusklike in appearance and exceptionally long. About three-fourths of the distance from the origin of the antenna to its distal end there is a slight swelling, distal to which the antenna tapers more abruptly and presents a feeble sigmoid curve. The terminal portion of the antenna is roughened by low ridges or curved welts,  $4\mu$  to  $5\mu$  high and  $15\mu$  to  $45\mu$  in length. In the region of the swelling of the antenna, just proximal to the narrower distal portion, these ridges become transformed into numerous crowded papillae of hemispherical shape,  $5\mu$  to  $12\mu$  high and  $11\mu$  to  $18\mu$  wide. These papillae cover the median and anterior sides of the antenna in this region. Interspersed with the papillae are numerous sensory hairs,  $30\mu$  to  $75\mu$  in length. At the borders of the papillose area the papillae become broader and flatter, often with a depression in the center, and gradually change over into curved ridges. The remaining portion of the antenna, proximal to the swollen papillose area, bears scattering circular aggregations of papillae, similar to those described in the male (pl. 78, fig. 3). The circular areas range from  $50\mu$  to  $270\mu$  in diameter and contain 7 to 85 papillae. The papillae are arranged in concentric rings about a sensory hair.

The peduncles of the eyes are partly overhung by the anterodorsal part of the head. In the center of the dorsal side of the head, between the eyes, is a sharply circumscribed area, square with rounded corners (pl. 78, figs. 1, 2; pl. 79, fig. 4), the so-called neck organ.

The labrum (pl. 79, fig. 4), which is large and conspicuous, extends from the ventral side of the front to beyond the mouth parts posteriorly and has a notch on each side that fits around the lower end of the mandibles. The posterior end is truncated but bears a

conspicuous median noselike process. The nasiform process and the expanded corners of the labrum are covered with stiff bristlelike hairs grouped in small oblong patches and comblike rows.

The mandible has a large heavy tooth at the posterior angle of the triturating surface. On the dorsal border of this surface the large tooth is followed by a wide gap, then by three or four heavy teeth, which diminish in size. The anterior and ventral borders are bordered by numerous small, needlelike teeth (pl. 77, fig. 4). Rows of small teeth extend inward from the bordering needlelike teeth toward the median line of the triturating surface in its anterior and ventral regions. The outer two or three teeth of each row bear sharp points, the remainder being blunt. The rows often bifurcate as they approach the center, and the teeth diminish in size toward the center (pl. 77, fig. 3).

Between the mandibles and the first maxilla, on each side of the median line, is a pyramidal elevation, roughly 4-sided at the base, about 1 mm in diameter, and covered with fine bristlelike hairs. The nasiform process of the labrum fits in between the apices of these pyramids. The bases of the pyramids block the anterior end of the ventral thoracic food groove, but obviously can be separated to permit the passage of nutriment.

The first maxilla has a strong conical tooth at the anterior corner of its median border, followed by 15 to 20 stout spines. The outer surface of the basal half of the maxillary spines is covered with peculiar flattened spinules, resembling the blade of a dagger, and the terminal half is covered with slender hairs (pl. 79, fig. 5).

The second maxilla is a small papillalike structure about 1 mm long, located near the base of the first phyllopodium. It is covered with groups of short hairs and bears about 10 plumose setae, which project medially.

There are 11 pairs of thoracic appendages (phyllopodia), the first pair of which is slightly smaller than those immediately following. Appendages 2 to 7, inclusive, are about the same size, 7 being perhaps the largest. Appendages 8 to 11 decrease rapidly in size, 11 being about one-half the size of 7. Plate 79, figures 1 and 2, depicts appendages in anterior and median views. The branchial lamina is triangular with serrate borders. The branchial sac (gill) is elliptical in outline. The exopodite is fringed with long plumose setae, shortest near the proximal end and longest (about  $1,400\mu$ ) at the distal end. Plumose setae of the same general type arise from the external border of the endopodite (pl. 78, fig. 4). These setae are similar to those of the exopodite but are more distinctly jointed at the base. They are shortest at the proximal end of the endopodite and longest near the apex, or inferolateral border, where they reach

a length of  $1,500\mu$ . Near the apex of the endopodite the last five or six setae become shorter and stouter, the fine delicate hairlets that border them become shorter and more bristlelike, and the setae transform rather abruptly to the hooked spines of the internal border of the endopodite.

A typical spine of the distal half of the median border of an endopodite is depicted in pl. 79, fig. 3. The tip is turned dorsally to form a hook with an arrowhead tip. On the dorsoposterior side of the spine a triangular area, outlined by a row of denticles about  $30\mu$  in length, extends from the hook about three-fourths the length of the spine toward its base. Inside this triangular area there is a dense aggregation of slightly shorter denticles, about  $22\mu$  in length, arranged in poorly defined oblique rows.

The number of these hooked spines varies somewhat in different appendages and also from individual to individual. Starting at the distal end of the endopodite of an appendage from the middle of the series there may, or may not, be a heavy, straight-tipped, denticulate spine. Next are six to nine denticulate spines with strongly hooked tips, of the type shown in pl. 79, fig. 3. The proximal 12 or 13 spines become progressively straighter at the tip and slenderer; the denticles become more closely set and delicate, and the area of denticles extends more completely around the spines until the last few (two to five) become slender, straight-tipped setae whose entire surface in the distal two-thirds is covered with fine hairs (pl. 80, fig. 2). In appendage 11 none of the denticulate spines has a strongly hooked tip.

The five endites are bordered by long setae of the type just described (pl. 80, fig. 2). Endites 1 and 2 are swollen and are nearly 1 mm in anteroposterior diameter. They bear a row of stout setae, which arise near the edge on the posterior side; endite 1 bears two setae near the anterior border, accompanied each by a small spur; endite 2 bears one such setae and spur. Endites 3 to 5 are broadly swollen, bearing 5 to 12 setae on the anterior border and 3 to 5 on the posterior border. Endites 3 and 4 bear each a long hairless seta in the center of the median surface.

The anterior and posterior surfaces of the tip and median border of the endopodite and of the border of all the endites are covered with fine, short, bristlelike hairs about  $15\mu$  in length, arranged in short comblike rows (pl. 79, figs. 1, 3; pl. 80, fig. 2). These fine bristles, the tips of which are directed medially and dorsally, thus form a broad band on both sides of the median borders of the appendages. The lateral walls of the ventral thoracic groove are also fringed with thickly set stiff hairs about  $50\mu$  in length (pl. 79, figs. 1, 2, *t. g.*).

The penes are eversible and retractile. In most of the specimens they are wholly retracted or only partially protruded. Plate 80,

figure 1 is a ventral view of the genital segments of the specimen in which the penes were farthest protruded. The penes in this individual are about 2.2 mm in length. On the inner side, near the proximal end, is a conical spur, 410  $\mu$  in length, and on the lateral side, near the distal end, is a rounded eminence, 360  $\mu$  in diameter, covered with short conical spines 20  $\mu$  in height. At the tip of the everted penis, on its lateral side, is a second eminence, about 200  $\mu$  in diameter, of similar appearance and spination.

The testes extend from some part of the third, or the anterior region of the fourth, abdominal segment anteriorly into the first genital segment. Near the junction of the two genital segments a vas deferens leaves each testis and courses ventrally and posteriorly to communicate with the penis. A large ventral outpocketing of the vas deferens near its junction with the penis serves as a seminal vesicle.

The ovaries originate in some part of the fourth or fifth abdominal segment and extend anteriorly into the seventh (rarely only into the eighth) thoracic segment. They are crowded with eggs of irregular or angular shape from mutual pressure. Near the boundary between the two genital segments a conspicuous oviduct passes from each ovary into the ovisac. The ovisac has an elongated piriform shape, thus differing from that of most species of the genus in which it is more or less fusiform. There are paired cement glands overlying the dorsal side of the egg mass for about three-fourths the length of the ovisac and extending laterally and ventrally to the egg mass in the proximal one fourth of the ovisac. By actual count the number of eggs present in the ovisacs of three specimens was 210, 256, and 595, respectively. Apparently mature eggs from preserved specimens are 580 $\mu$  (570 $\mu$ –595 $\mu$ ) in diameter.

There are seven abdominal (postgenital) segments. The terminal one is bifurcated and bears the anus, which is a vertical slit at the junction of the two short limbs of the bifurcation. Each cercopod is attached to the ends of the seventh segment by an obscure articulation. The cercopods curve outward, often with a slightly spiral twist (pl. 80, fig. 3).

*Remarks.*—*Branchinecta gigas*, by far the largest known species of the genus, is the fourteenth species of *Branchinecta* to be described and the fifth reported from North America. Only *B. ferow* (Milne Edwards) from eastern Europe and Asia Minor, in which the males reach a maximum length of 51 mm, the females of 70 mm, approaches this new species in size. *B. gigas* differs from all known species of the genus in its large size and in having the antennae of the female as long as those of the male. It is the only species known that is wholly without tubercles, processes, or denticulations on the

inner aspect of the basal article of the male antenna (Daday de Deés, 1910, fig. 121, p. 157, figures *B. orientalis* with a roughened tubercle ["tuberculo rotundato, scabroso"] on the basal article of the antenna, which, however, Bond, 1934, p. 34, describes as a "slight setulose or smooth bulge").

Only two species of *Branchinecta* resemble *B. gigas*, namely, *B. ferow* (Milne Edwards) and *B. orientalis* Sars. *B. ferow* differs from *B. gigas* in that the antenna of the male has a large roughened tubercle on the inner aspect of the basal article; the antenna of the female is short, scarcely longer than the antennule, and flattened; the ovisac is elongate-fusiform, and both sexes have a narrow triangular process on the posterior end of the labrum.

*B. orientalis* Sars differs from *B. gigas* in the following features: The basal article of the antenna of the male is relatively shorter and stouter; the antennae of the female are short, about the length of the antennule, broad, flat, and ending in a short lateral point separated by a notch from the broad part of the antenna; the ovisac is fusiform; in both sexes the posterior end of the labrum bears a vertical lamella, the cercopods are fringed with setae nearly to the base on both sides, and the lamina branchialis is roughly quadrangular in shape.

#### LITERATURE CITED

BOND, R. M.

1934. Report on phyllopod Crustacea (Anostraca, Notostraca, Conchostraca) including a revision of the Anostraca of the Indian Empire. [Yale North India Expedition.] Mem. Connecticut Acad. Arts and Sci., vol. 10, art. 5, pp. 26-62, 19 figs.

DADAY DE DEÉS, E.

1910. Monographie systématique des Phyllopodes Anostracés. Ann. Sci. Nat., ser. 9, vol. 11, pp. 91-489, 84 figs.

#### EXPLANATION OF PLATES

Plate 77, figures 3 and 4; plate 78, figures 3 and 4; plate 79, figures 3 and 5; and plate 80, figures 2, 5, and 6 were drawn with the aid of a camera lucida. The remaining figures were made without the aid of drawing apparatus but with all proportions conforming to careful measurements of the specimen.

#### Abbreviations

a.=Area of attachment of first thoracic appendage.	ex.=Exopodite.
br. l.=Branchial lamina.	l.=Labrum.
br. s.=Branchial sac, or gill.	mx. 2=Second maxilla.
c. g.=Cement gland.	na. p.=Nasiform process of labrum.
end.=Endopodite.	n. o.="Neck organ."
ent. 1=Endite 1.	ov.=Ovary.
ent. 5=Endite 5.	t. g.=Lateral border of thoracic groove.

## PLATE 77

1. Male specimen.  $\times 2$ .
2. Female specimen.  $\times 2$ .
3. Two adjacent rows of teeth from the anteroventral portion of the triturating surface of a mandible, seen from above. Not all the rows are bifurcated, as are those of the illustration.  $\times 460$ .
4. Triturating surface, left mandible of a female, oblique view.  $\times 240$ .

## PLATE 78

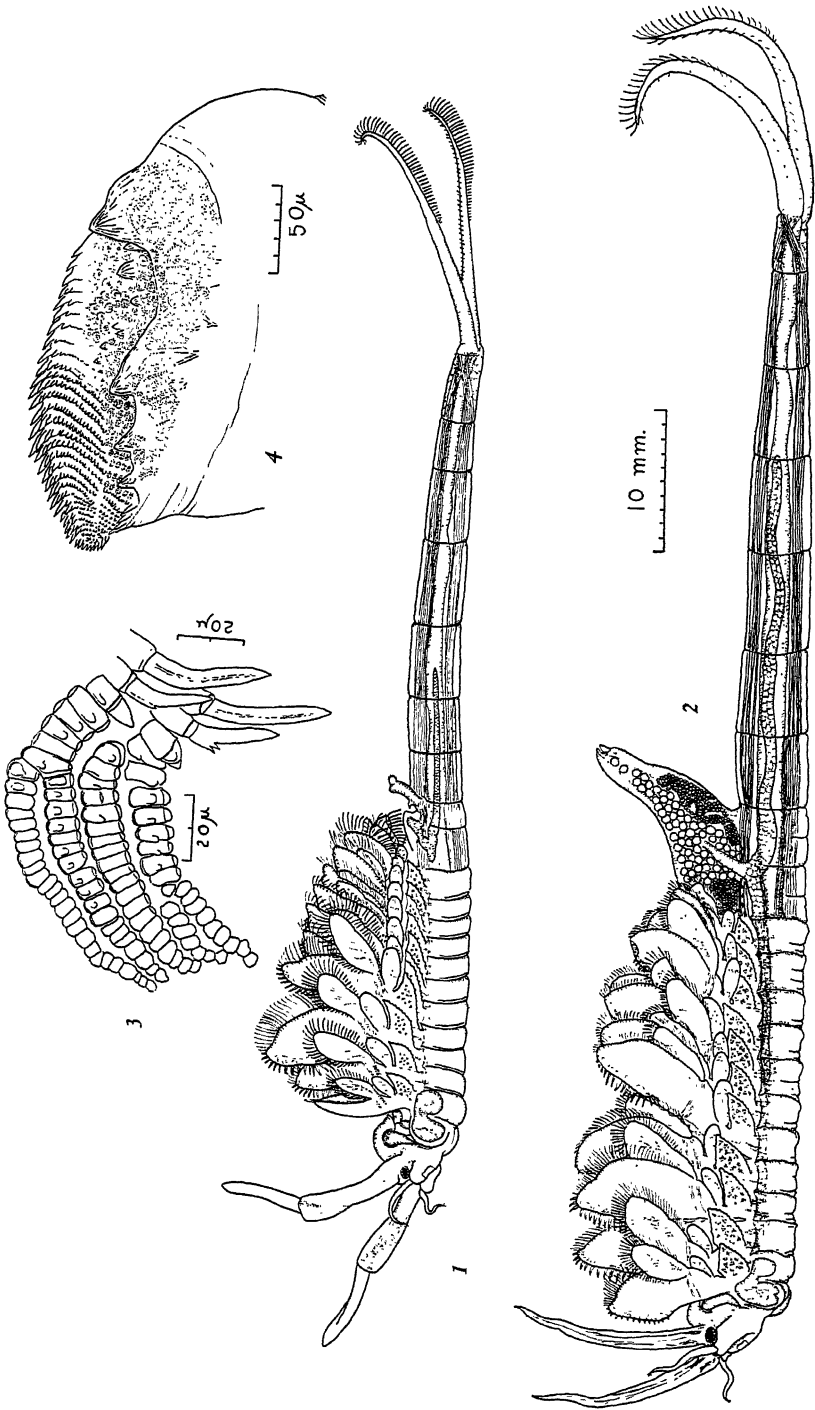
1. Anterodorsal view of head of a male.  $\times 4$ .
2. Anterodorsal view of head of a female.  $\times 4$ .
3. Papillae and sensory hair from proximal portion of antenna of a female. Similar papillae and hairs occur on the basal article of the male antenna.  $\times 460$ .
4. Seta from the ventrolateral border of the endopodite of a thoracic appendage.  $\times 108$ .

## PLATE 79

1. Left fifth thoracic appendage of a female, anterior aspect.  $\times 6$ .
2. Left seventh thoracic appendage of a male, median aspect.  $\times 6$ .
3. Hooked denticulate spine from the right seventh thoracic appendage, posterior aspect, showing comblike rows of stiff hairs on the border of the endopodite.  $\times 108$ .
4. Lateral view of head and first thoracic segment of a female.  $\times 4$ .
5. Portion of seta from the first maxilla, showing the daggerlike spinules of the basal half and the hairs of the terminal half.  $\times 460$ .

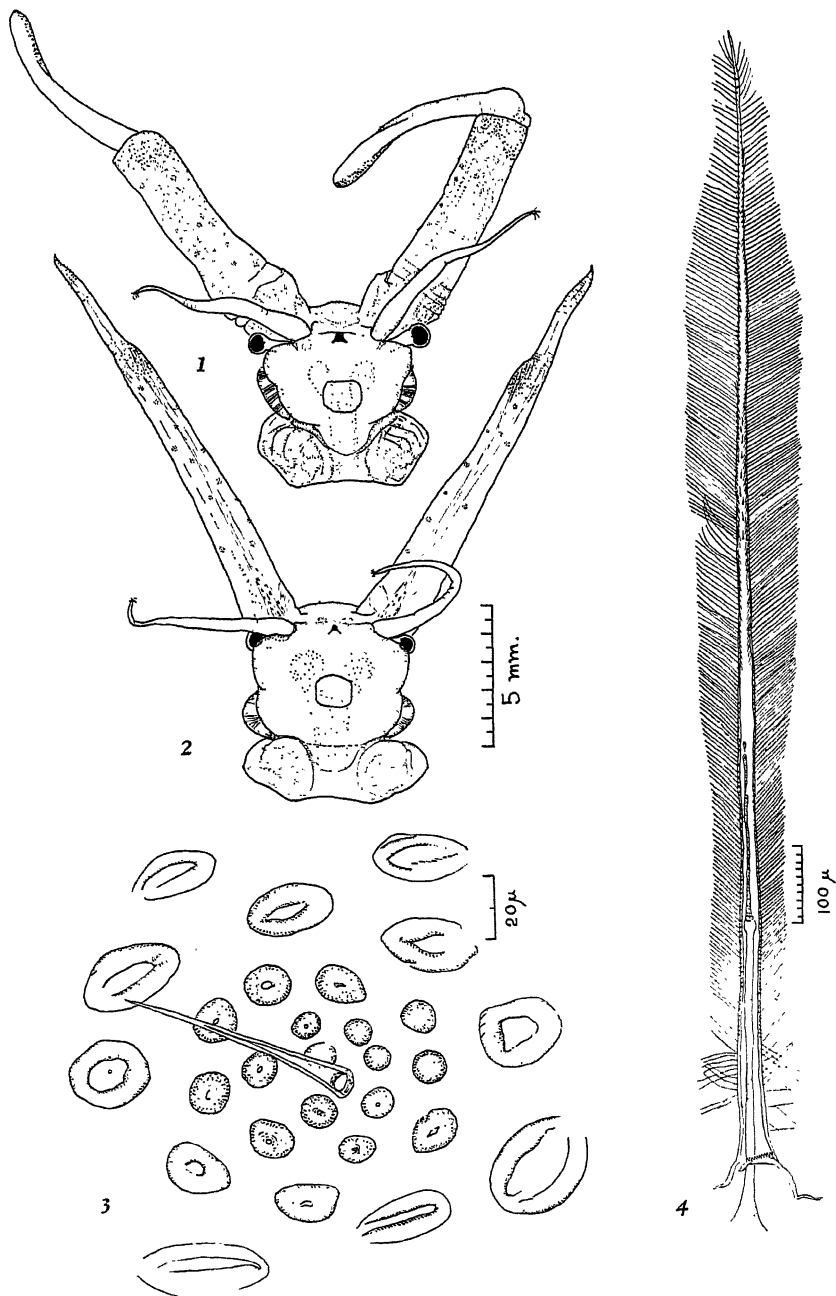
## PLATE 80

1. Ventral aspect of male genital segments, with everted penes.  $\times 10$ .
2. Plumose seta of the type found on the endites and the proximal portion of the median border of the endopodite, showing the comblike rows of hairs on the border of the endite.  $\times 460$ .
3. Ventral aspect of the terminal segment of the abdomen, and the cercopods.  $\times 4$ .
4. Genital segments and ovisac of a female, lateral aspect.  $\times 6$ .
5. Papillae, from the distal end of the second article of the antenna of a male, in end view.  $\times 460$ .
6. Papillae, from the distal end of the second article of the antenna of a male, in side view.  $\times 460$ .



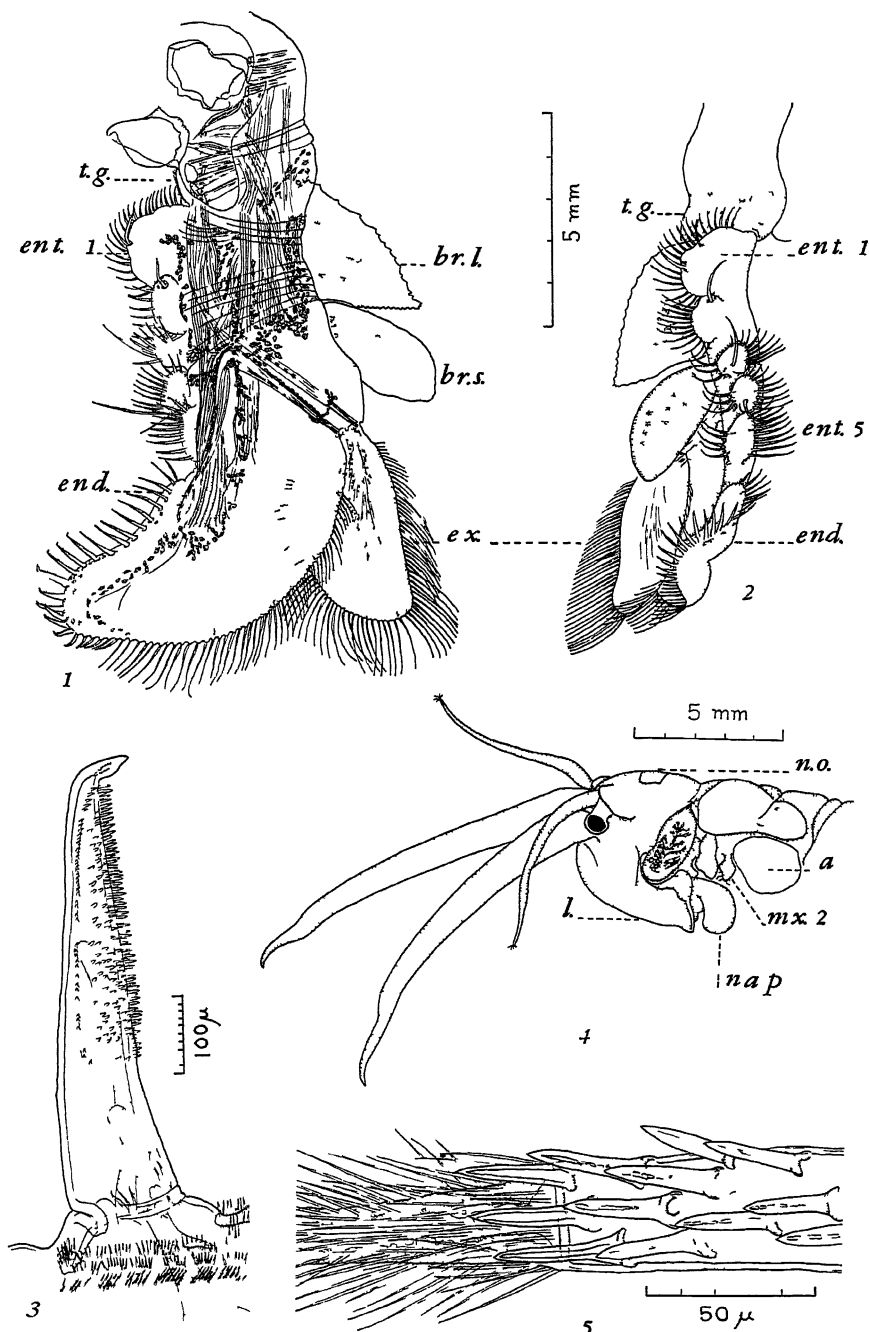
BRANCHINECTA GIGAS, NEW SPECIES.  
FOR EXPLANATION OF PLATE SEE PAGE 562.





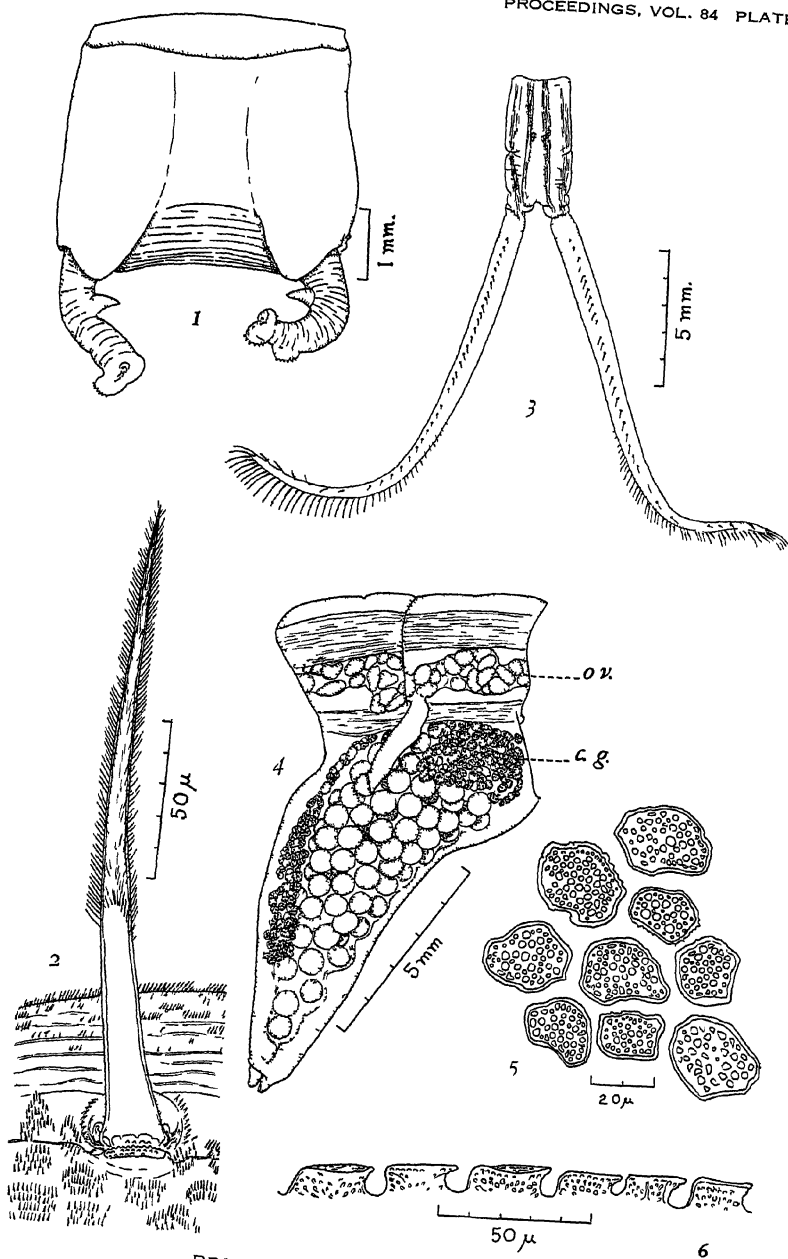
BRANCHINECTA GIGAS, NEW SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 562.



BRANCHINECTA GIGAS NEW SPECIES

FOR EXPLANATION OF PLATE SEE PAGE 762.



BRANCHINECTA GIGAS NEW SPECIES

FOR EXPLANATION OF PLATE SEE PAGE 562



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NEW SPECIES OF MOTHS OF THE FAMILY NOTODONTIDAE IN THE UNITED STATES NATIONAL MUSEUM

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By WILLIAM SCHAUS

*Bureau of Entomology and Plant Quarantine, United States Department of Agriculture*

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Two NEW genera and 37 new species of notodontid moths are described in this paper. Most of the specimens on which these descriptions are based were received for identification from collectors in Tropical America; others were presented by Frank Johnson, of Glen Ridge, N. J., a most generous contributor to the national collection of Lepidoptera.

**Genus PROELYMIOTIS Schaus**

**PROELYMIOTIS RHETESA, new species**

*Male*.—Head tufts fuscous below, pale vinaceous-drab above; collar pale vinaceous mottled with black hairs. Thorax covered by the patagia, which are pale vinaceous-drab, dorsally edged with fuscous hairs. Abdomen dorsally deep brownish drab at base, otherwise pale vinaceous-drab, underneath pallid purple-drab. Fore wing above with base and costal margin broadly light brownish drab from antemedial line to apex; a subbasal, very irregular black line not reaching inner margin, upbent to antemedial at subcostal; antemedial outcurved to a black line on basal half of submedian; all proximally edged below by a fine, pale vinaceous-drab line; a black point at upper angle of cell and a similar spot below it on vein 4; a pale vinaceous-drab streak below cell and vein 5; a double, dark excurved postmedial line,

outbent on costa, then slightly inbent, more deeply inbent below; vein 4 distally edged with white to submedian fold, followed by a sinuous inbent black line from termen at vein 4 to submedian fold; subterminal fuscous spots from vein 7 to vein 4 partly followed by white streaks; cilia pale ecru-drab with paired short black streaks at tips of veins. Hind wing light drab with whitish suffusions postmedially; cilia pale vinaceous-drab. Wings below pale cinnamon-pink; traces of antemedial line and dark purplish suffusions below costa, expanding but not reaching apex of termen; the postmedial line indicated.

Expanse, 34 mm.

*Habitat*.—Nova Teutonia, Brazil.

*Type*.—U.S.N.M. no. 34680.

### Genus LEPASTA Möschler

#### LEPASTA CANOLA, new species

*Male*.—Palpi fuscous, the tip of second joint white; frons white; the frontal tuft greenish gray, with a few black points and hairs. Collar and thorax dark citrine, the patagium with a lateral black line. Abdomen above citrine-drab, paler at base and on terminal segment, underneath vinaceous-white. Fore wing with base of inner margin vinaceous-white followed by a triangular olive-green spot partly edged with black; a small olive streak below base of cell, and a dark olive-green streak below base of costa, the space below it white irrorated with green, which becomes denser to inner margin beyond the triangular spot; before middle of costa a dark outbent streak extending to a deep grayish-olive spot, which is closely followed by an upturned spot, and this by an upturned linear spot; these spots edged above by white to the green edge of costa, and all limited by a curved line from vein 7 to vein 3, where it is incurved to a point at inner margin, the proximal side of the line dark green; termen broadly serpentine green crossed by a broken black, partly lunular, line, inwardly edged by brighter green; a terminal black line forming spots toward tornus. Hind wing whitish on costa and inner margin; a dull citrine medial space; termen grayish olive. Fore wing below with the inner margin greenish white, the termen olive-buff; a dark olive subterminal fascia. Hind wing below greenish white, the inner margin whiter; dark subterminal spots between veins 4 and 3 and a narrow dark terminal shade.

Expanse, 36 mm.

*Habitat*.—Espírito Santo, Brazil.

*Type*.—U.S.N.M. no. 34672.

Allied to *Lepasta maltha* Schaus.

Genus *PSILACRON* Felder*PSILACRON PANCHUYA*, new species

*Male*.—Palpi fuscous below, pale vinaceous-fawn above; a spot of similar color on frons, the vertex fuscous. Collar and thorax deep grayish olive. Abdomen above snuff brown, the segments posteriorly fuscous; the terminal segment and anal hairs tiller buff; abdomen below pale grayish vinaceous. Fore wing largely pale cinnamon-pink; some grayish-olive mottling at base, and antemedial citrine-drab streaks between the veins, followed on costa by a white point and a faint dark line; a grayish-olive patch from costa and discocellular to near termen, edged below from costa by an irregular black curved line not extending below vein 3, containing a buffish spot on costa postmedially; the medial and terminal space like the ground color; terminal dark streaks on veins from apex to vein 2, connected by a dark terminal line, and forming spots on the pale cilia; some dull citrine suffusions along inner margin. Hind wing white, the veins terminally with fine dark streaks; a dark olive spot at apex, preceded by a line from costa; inner margin preceded by a benzo-brown streak from base, expanding near termen. Wings below white, the fore wing with the costal patch indicated, the hind wings with traces of the markings.

Expanse, 42 mm.

*Habitat*.—Pueblo Guasca, Colombia.

*Type*.—U.S.N.M. no. 34670.

Two male specimens.

Genus *URGEDRA* Dyar*URGEDRA BENCA*, new species

*Male*.—Palpi fuscous, fringed with pale mouse gray; vertex drab, the collar pale mouse gray crossed by a wavy black line. Thorax dark olive-buff, the patagia outwardly and tips whitish. Abdomen dark olive-buff, with transverse fuscous lines and a similar broken dorsal line, the anal hairs mottled with pale vinaceous-fawn hairs, underneath vinaceous-buff. Fore wing with base of costa, cell and termen lime green; basal and subbasal short black lines on costa; an antemedial punctiform line; the spot in cell conspicuous; medial space from costa to near submedian suffused with pale hydrangea pink; a fine black line on discocellular; a fine subterminal line of small black spots, preceded by lime-green scaling, followed by some hydrangea-pink scaling and terminally by lime green with a submarginal series of small black lunules on interspaces; cilia buffy brown with clusters of whitish hairs at tips of veins. Hind wing avellaneous, the base greenish white; cilia white with dark scaling at tips of veins. Fore wing below light

cinnamon drab with a broad subterminal drab shade; cilia drab, with pale hairs at tips of veins. Hind wing below white, the costa with livid pink irrorations.

Expanse, 35 mm.

*Habitat*.—Pueblo Guasca, Colombia.

*Type*.—U.S.N.M. no. 34671.

#### Genus *DICENTRIA* Herrich-Schäffer

##### *DICENTRIA PELIALIS*, new species

*Male*.—Palpi black above, the fringe pale vinaceous. Head vinaceous-buff; collar cinnamon-drab. Thorax and patagia vinaceous-buff. Abdomen above dark vinaceous-drab, the anal hairs vinaceous. Fore wing with base whitish vinaceous limited by a black line from costa not reaching below submedian; antemedial space mostly dark vinaceous-gray with some wood-brown scaling below cell and on inner margin; a white streak at end of cell adjoining an upcurved velvety black line and continuing as a fine line along vein 5; costa on outer half with white points; termen to tornus mostly vinaceous-buff; from below vein 5 two fine darker postmedial lines partly edged with some black scales, outbent below vein 2; terminal black spots at most of the veins, those at tornus larger. Hind wing white, the veins finely dark-streaked ending in small spots on termen; inner margin broadly dark olive-buff. Wings below whitish, the veins finely dark; dark vinaceous-drab suffusions on fore wing from base to middle of costal margin; a faint subterminal drab-gray shade.

Expanse, 38 mm.

*Habitat*.—Santa Clara, Cuba.

*Type*.—U.S.N.M. no. 34674.

#### Genus *MISOGADA* Walker

##### *MISOGADA CANOTA*, new species

*Male*.—Head, collar, and thorax light brownish drab with a few white hairs, the collar edged posteriorly with black. Abdomen whitish gray, the middle segments darker; underneath white. Fore wing largely silvery white with dark irrorations; base white with a double sinuous subbasal line, followed by darker shading and a double sinuous antemedial black line; the costa mostly darker to beyond middle; the irrorations forming a faint, broken medial line; postmedial line double, fine, black, wavily inbent, the outer line followed by purplish and fuscous spots from costa to below vein 5; a marginal broken black line, lunular from vein 4 to tornus; a faint terminal dark line; the cilia lilacine with dark mottling. Hind wing whitish with lilacine suffusions, the termen narrowly and inner margin broadly light drab; cilia basally with dark spots, the tips lilacine. Fore wing below, with base and

inner margin broadly white, the costal and apical portion largely violaceous, the costal margin from beyond base narrowly white, crossed by fine dark lines toward apex. Hind wing below white, the termen at apex narrowly violaceous, and with fainter lunules at base of white cilia.

Expanse, 37 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 34682.

A male and female received from J. F. Zikan.

#### COXEYA, new genus

*Male*.—Antenna thickened at base and excurved, with a slight tuft then rapidly becoming slender and with minute bristles. Palpi upturned to vertex, the second joint hairy, the third short and smooth; legs very hairy, especially the hind tibiae and tarsi. Fore wing fairly broad, the apex acute, the outer margin curved; veins 3 and 4 apart, 5 from middle of discocellular; 6 from upper angle; areole small; 7, 8, 9 and 10 from end of areole. Hind wing rather long, the termen well rounded; veins 3 and 4 from a point; 6 and 7 shortly stalked; 8 diverging near end of cell.

*Type*.—*Coxeya sinistra*, new species.

*Remarks*.—The genus is named for my friend W. Judson Coxey. It appears to be most similar to *Hippia* Möschler, resembling this especially in the antennal structure.

#### COXEYA SINISTRA, new species

*Male*.—Base of antenna white where excurved, followed by dark brown in tuft. Palpi whitish buff above, edged below with black, the third joint black; vertex buffy brown; collar snuff brown. Patagia paler mottled with white hairs, the dorsal edge black; some silvery scales on metathorax. Abdomen dorsally greenish buff at base with a dorsal fuscous spot, otherwise greenish buff with darker transverse lines; underneath pinkish buff, also the large tufts of hair, so prominent on hind tibia. Fore wing dark olive with brownish suffusion on basal third of costa and cell and a similar shade in bent from costa near apex, proximally edged by a double lunular black line filled in with olive-buff scales; some pale scales at base of inner margin. Hind wing light brownish olive; some white scaling on inner margin and anal angle; cilia white with some brownish hairs. Wings below dark vinaceous-drab, the termen narrowly and cilia pinkish buff, the fore wing with the costa narrowly light vinaceous-cinnamon, with five fuscous spots before apex, the hind wing with avellaneous suffusions at base.

Expanse, 40 mm.

*Habitat*.—Dos Puentes, Ecuador.

*Type*.—U.S.N.M. no. 34684.



Genus **SALLUCA** Schaus**SALLUCA OSCARINA**, new species

*Male*.—Palpi fuscous fringed with pale ecru-drab. Antenna with the shaft black, the pectinations buff-gray. Head and thorax grayish white mottled with fuscous hairs, the collar posteriorly benzo brown, the tips of patagia also benzo brown. Abdomen above pale russet-vinaceous, with a medial lilacine-white line; the last segment and anal hairs light brownish vinaceous, underneath lilacine-white with slightly darker transverse lines. Fore wing with a large lilacine-white basal patch edged by an irregular cinnamon-brown line on costal edge to below cell expanding into a broad fascia with a dentate edge; above base of inner margin a fine line extending from below cell, down curved and angled; the rest of the wing pale lilacine white irrorated with grayish scales on postmedial space and inner margin; a double reddish line on costa postmedially; a subterminal fine pinkish-cinnamon dentate line, partly interrupted. Hind wing cinnamon-buff, the costa and a short postmedial fascia whitish. Wings below white, the costa of fore wing pinkish cinnamon.

Expanse, 44 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 34663.

Closely allied to *S. schausi* Dognin but the subterminal line quite different.

Genus **DISPHRAGIS** Hübner**DISPHRAGIS COROSINA**, new species

*Male*.—Palpi mostly fuscous; head and collar cinnamon-drab. Thorax and patagia mottled vinaceous-drab, black, and white. Abdomen above cinnamon-drab with black dorsal spots on terminal half; underneath pale pinkish buff with medial light grayish scaling. Fore wing greenish white with basal, antemedial, and postmedial fuscous lines; costa with fuscous spots and lines on costal edge; black basal points on costa and below cell followed by larger subbasal spots; a line below submedian from base to middle of inner margin; an antemedial series of mostly lunular spots, outbent and irregular in shape; a double medial broken line, the distal line broader and mostly continuous, in end of cell filled in with pale buff scaling; the basal half of wing irrorated with dull citrine, also postmedially at costa; termen broadly paler; a fine subterminal sinuous line mostly macular; termen with small lunules on interspaces. Hind wing greenish white with broad postmedial and subterminal darker suffusions; some short dark lines on costa. Wings below whitish green; some darker shading on costa of fore wing.

Expanse, 40 mm.

*Habitat*.—Espirito Santo, Brazil.

*Type*.—U.S.N.M. no. 34686.

**DISPHRAGIS AVICANS, new species**

*Female*.—Head and thorax warbler green, the patagia edged with black hairs. Abdomen above buff-brown with transverse citrine lines; underneath white, the legs mostly yellowish green. A large warbler-green space from base of costa, its anterior edge outangled on subcostal, then slightly incurved and angled on vein 2, incurved and downbent to submedian and irregularly upbent to base below cell, the inner margin at base with some white mottling; the large green space crossed by a wavy black vertical line with a few grayish scales on its edges; the postmedial space lilac-buff varied with warbler green, broad on costa, oblique and narrow at tornus, limited by a lunular black line, which is incurved below vein 3 to inner margin; a small black spot in cell; the apex broadly and termen below vein 4 narrowly warbler green with subterminal dentate black spots from vein 7 to vein 4; the termen below vein 4 with lilac-buff mottling. Hind wing vinaceous-white, the termen broadly light drab, the cilia pale drab-gray. Fore wing below pale brownish drab with whitish suffusions on interspaces. Hind wing below white.

Expanse, 47 mm.

*Habitat*.—Jepelacio, North Peru.

*Type*.—U.S.N.M. no. 34659.

**DISPHRAGIS SALMA, new species**

*Male*.—Palpi black fringed with white; shaft of antenna gray, the pectinations white; head white with a dark curved line. Collar and thorax pallid purplish gray mottled with white, the thorax slightly darker. Abdomen white with a slight grayish tinge. Fore wing with a large triangular space from base of costa to outer line, edged below by a wavy dark line from base of cell to antemedial line; the base of inner margin white with lilacine mottling; antemedial line irregular on costa, broken, below cell somewhat lunular to inner margin: an upright dark medial line in cell, outangled below cell, inangled on submedian; postmedial line fine, outangled on costa, fine light brown on discocellular where it joins the outer line, fuscous, incurved opposite cell, with a double lunule between veins 4 and 3, inbent and sinuous to inner margin; a short black line below base of vein 3 extending outwardly and, from costa to vein 3, broadly shaded proximally with hair brown; a short black streak on inner margin near base; termen broadly ecru drab cut by the fuscous veins; a subterminal fuscous line; cilia lilacine with dark hairs at tips of veins. Hind wing somewhat hyaline smoky gray, the costa and inner margin

white, opaque; cilia white. Fore wing below glossy lilacine white, the costa light vinaceous fawn with white points and black spots toward apex. Hind wing below as it is above.

Expanse, 38 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 64657.

Received from J. F. Zikan.

**DISPHRAGIS TAPPERTI, new species**

*Male*.—Head and thorax serpentine green. Abdomen above light grayish olive, the two terminal segments pale drab-gray, underneath pale vinaceous-buff. Fore wing largely pale vinaceous-fawn; base darker, followed by a broad buff-olive fascia outbent from costa to submedian, crossed and edged by irregular black lines; the medial space crossed by irregular and broken olivaceous lines; a pale spot at discocellular edged by fine dark lines; a postmedial fine black line outcurved from costa, angled at vein 3, and incurved to inner margin before tornus, in places double, followed on costa by a large yellowish green triangular spot, terminal space pale with a fine broken subterminal line; a fine dark terminal line; the cilia with small black spots at tips of veins. Hind wing whitish, the inner margin, apex, and termen suffused with avellaneous. Fore wing below white, the costa with a broad dark brownish-drab streak, not reaching termen. Hind wing below white.

Expanse, 37 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 34664.

Received from J. F. Zikan.

**DISPHRAGIS SAPANI, new species**

*Male*.—Palpi tipped with fuscous; frons white; vertex and front of collar vinaceous. Collar apically and thorax dark olive-buff. Abdomen above dark olive-buff with pale transverse lines, underneath olive-buff with slightly darker transverse lines. Fore wing with base deep colonial buff crossed by two fuscous lines, followed on costa by a short fuscous fascia to below cell, and on inner margin by a short fuscous line; fore wing otherwise mostly dark grayish olive; a fine double darker antemedial line on costa and from cell to inner margin; a broader medial line on costa, across end of cell and from base of vein 3 excurved to vein 2 near termen, then downbent to tornus forming a small black-edged spot; on discocellular a narrow buffish, dark-edged line; a dark postmedial linear shade from costa to vein 5, with fine dark lines, partly double, below it; a subterminal pale shade from costa to vein 5, then macular to vein 3, crossed distally on each inter-

space by a very fine dark line. Hind wing slightly whitish at base, the outer two-thirds dark olive-buff, the cilia whitish. Fore wing below brownish drab, the inner margin and apex white. Hind wing below whitish, the termen broadly suffused with pale brownish drab.

Expanse, 38 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 34665.

Received from J. F. Zikan.

**DISPHRAGIS LAOSOMA, new species**

*Male*.—Head, collar, and patagia mottled drab, white, and black, the thorax black. Abdomen above with the hair brown, the anal hairs light grayish olive with a few intermingling black hairs. Fore wing with base mottled vinaceous and black, crossed by a subbasal curved black line, followed by an antemedial black fascia outbent from costa to below cell, then continuing as an inbent black line to inner margin, preceded below cell by a mottling of pale green, white and black scales; the fascia followed on costa by a fine wavy black line, dentate, lunular, inbent from below cell to inner margin; the cell mostly deep olive and fuscous, crossed by two black lunules, pale edged; the post-medial line fuscous, very irregular and broken, followed on costa by a deep grayish olive, elongated spot, not reaching apex; termen above tornus to vein 4 mottled white, pale green and fuscous; a subterminal dark shade from below vein 6, expanding below vein 5, reduced and dentate below vein 4; terminal black lunules on interspaces, the cilia with black at tips of veins. Hind wing with the inner margin deep colonial buff and similar suffusions medially; termen deep drab, the cilia white. Fore wing below with the hair brown, the inner margin and base whitish. Hind wing below with the hair mostly brown; a large whitish spot at anal angle.

Expanse, 39 mm.

*Habitat*.—Espírito Santo, Brazil.

*Type*.—U.S.N.M. no. 34677.

**DISPHRAGIS HOSMERA, new species**

*Male*.—Palpi above and frons light grayish olive. Collar light grayish olive mottled with dark hairs in front and with white scaling; thorax fuscous, the patagia light grayish olive. Abdomen above buff-brown at base, otherwise deep olive-buff, with dark segmental lines white underneath. Fore wing with the base pale pinkish buff with a yellow, black-edged, round spot below cell; basal third of wing grayish olive, this area edged distally by a fine black, lunular line; space beyond to termen, and from costa to vein 3, light grayish olive, the costal edge darker, crossed by some short black lines: black points on

veins medially and postmedially; a white, black-edged lunule on inner margin at tornus with some dark subterminal shading above it to vein 3. Hind wing white, the costal margin dull green crossed by post-medial dark lines, the inner margin with a tawny-olive streak not reaching anal angle. Wings below white, the fore wing with olive shading along costa and black cilia at tornus, the hind wing with heavier white scaling on margins.

Expanse, 40 mm.

*Habitat*.—Espírito Santo, Brazil.

*Type*.—U.S.N.M. no. 34678.

Two male specimens.

### Genus RHUDA Walker

#### RHUDA ASTRIDA, new species

*Female*.—Head and front of collar vinaceous-buff, collar otherwise black; thorax and patagia white slightly mottled with black hairs. Abdomen with basal segment white with a V-shaped black line, otherwise dorsally avellaneous with black segmental lines, underneath mostly vinaceous. Fore wing with a black fascia from base of costa, this fascia outbent within and below cell, and upcurved toward median and vein 2, then downbent along vein 2 and again upbent subterminally to below vein 4, subterminally becoming narrow and strongly edged distally with a lunular white line followed by a mouse gray line; the inner margin white with a black point below cell, and slightly mottled with gray to a brownish patch postmedially; above the fascia the wing largely light vinaceous-fawn; an antemedial broad black streak on costa, and a short streak in cell with a downbent line on discocellular; fuscous streaks on interspaces beyond cell; a post-medial outbent dark line with an angled white spot above it. Hind wing whitish, the veins with dark lines expanding slightly subterminally; a faint postmedial line; the inner margin with brownish gray suffusions. Fore wing below whitish iridescent, the costa and inner margin with brownish gray suffusions; subterminal dark patches and streaks, edged with white distally from vein 4 to tornus. Hind wing below similar, with a distinct outcurved postmedial line, and a brown spot at anal angle.

Expanse, 76 mm.

*Habitat*.—Rio Topo Oriental, Ecuador.

*Type*.—U.S.N.M. no. 34662.

Collected by W. C. MacIntyre and received from Dr. B. Preston Clark.

#### NOCTULODES, new genus

*Female*.—Antenna simple, palpi upturned, straight, the second joint reaching well above head, thickly scaled; third joint half the

length of second, smooth. Fore wing long and moderately broad, the costa straight, apex rounded, termen slightly curved; vein 2 well before vein 3; 3 and 4 from a point; 5 from middle of discocellular, areole very narrow with vein 6 from beyond middle, 7, 8, 9, and 10 from end of areole. Hind wing long and moderately broad; costa slightly curved beyond base, then straight, the termen rounded; veins 3 and 4 and 6 and 7 stalked; 8 diverging from cell near end.

*Type*.—*Noctulodes porpara*, new species.

*Remarks*.—This genus does not appear to be closely related to any described genus of Notodontidae.

NOCTULODES PORPARA, new species

*Female*.—Head, collar, and thorax benzo brown, the patagia deep brownish drab, dorsally edged with buff scaling and with fuscous lines. Abdomen above purple-drab, irrorated with some buff scales; a dorsal fuscous line on the basal two segments; similar fine segmental lines, and a black spot on last segment; a lateral vinaceous-buff line with black spots; broad fuscous transverse lines ventrally. Fore wing with costal edge fuscous, the area below it to cell, as well as the base, buff brown with dark irrorations; the cell anteriorly dark purplish drab; base of median vein black; a black subbasal spot below cell; the cell posteriorly somewhat vinaceous; space below cell to inner margin pale brownish drab thickly irrorated with black scales; a double black wavy antemedial line from cell to inner margin; the submedian and edge of inner margin black; a double, thick, black, incurved line across end of cell; a double postmedial black line filled in with pale vinaceous from vein 6 to vein 4, the outer line outangled on vein 4, then incurved and lunular to vein 3, then macular with oblique streaks above inner margin, followed partly by some dull pinkish scaling, and this by a thick black curved line below vein 8, this line indentate below veins 7 and 6; a small bright vinaceous spot below costa before the subterminal line, the latter line black, sinuous, and becoming lunular below vein 4; a fine terminal black line. Hind wing natal brown, the inner margin broadly suffused with vinaceous-white. Fore wing below light vinaceous-drab; a dark medial line and an indistinct subterminal line; some white spots on costa toward apex; the vinaceous spot present. Hind wing below pallid purple drab, with an irregular curved, dark medial line; the termen with light vinaceous-drab suffusions.

Expanse, 42 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 34685.

Received from J. F. Zikan.

Genus **CHADISRA** Walker**CHADISRA SELANA**, new species

*Male*.—Head, collar, and thorax mottled mouse gray, white, and fuscous, the patagia with white predominating, the collar, and the patagia outwardly, edged with black. Abdomen above dark vinaceous-gray with paler transverse lines, the anal hairs pale drab-gray; underneath pale drab-gray with smoke-gray transverse lines. Fore wing with the medial space and tornus silvery white irrorated with light drab; some white at base edged by a sinuous thick black subbasal line, double on costa; base of costa to antemedial benzo brown, the antemedial black, sinuous, incurved from costa, and excurved below vein 3 to below vein 2, forming two prominent lunules to inner margin; the irrorations forming a faint, broken, medial line; postmedial line fine, black, incurved, lunular, partly double below vein 3, closely followed by a black line, distally edged with Rood's brown, broadly so from costa to vein 5, more narrowly from there to vein 3; a marginal series of prominent black lunules connected terminally by a fine black line; cilia gray with dark hairs. Hind wing with inner margin and termen olive-brown; otherwise dark olive-buff, thinly scaled. Fore wing below pale at base, terminally broadly citrine drab; costa beyond base pale vinaceous-fawn, and with a white spot at apex; an indistinct postmedial line; cilia whitish. Hind wing below whitish, the termen narrowly light brownish drab.

Expanse, 37 mm.

*Habitat*.—Espírito Santo, Brazil

*Type*.—U.S.N M. no 34681.

Genus **MERAGISA** Schaus**MERAGISA MUCIDARA**, new species

*Male*.—Palpi fuscous, buffish above. Head and thorax mottled grayish olive and light drab, with yellowish hairs extending from metathorax. Abdomen above deep grayish olive with transverse pale lines, the terminal segments light mouse gray, the underside buff. Fore wing with base of costa and a broad space in end of and below cell to postmedial line serpentine green; a subcostal fuscous line from base to first medial line, with three black points below it in cell and three fuscous spots above it on costa; the first postmedial line very irregular and sinuous to inner margin, preceded below cell and vein 2 by three black lines angled on submedian, curved anteriorly above cell and filled in with greenish white; the second and third medial lines excurved to vein 2, then downbent to inner margin; the postmedial space light but dull greenish yellow, crossed by double black lunules on the interspaces and thick black streaks on some of the veins; apex

broadly dull citrine with a fuscous apical spot; a fine subterminal wavy black line and a similar marginal line; cilia with black spots on interspaces. Hind wing deep grayish olive with some pale greenish scales at base; a dark olive buff shade in and below cell; cilia white. Fore wing below roman green, the apex to vein 5 greenish yellow. Hind wing below greenish yellow; the termen below apex, and a streak inbent between veins 5 and 6, roman green.

Expanse, 43 mm.

*Habitat*.—Pumayaca, Peru.

*Type*.—U.S.N.M. no. 34668.

**MERAGISA CAULINA, new species**

*Male*.—Head and collar light mouse gray; thorax pallid mouse gray. Abdomen above grayish olive, with darker segmental lines; the last segment and anal hairs pallid mouse gray. Body underneath pale grayish vinaceous. Tarsi black, the fore legs fringed with white. Fore wing pallid mouse gray, irrorated with darker gray scales; lines fine, deep mouse gray; a wavy subbasal line from costa to submedian; antemedial line fuscous, double, outbent from costa across cell, fine and inbent below cell, then outbent and lunular; medial line outangled on costa, with a black line on discocellular, then after being obsolete for a space continued as a very faint lunular line to inner margin; postmedial line double, outcurved on costa, incurved opposite cell, then single, wavy to inner margin; a fine marginal lunular line; cilia white. Hind wing brownish drab, the inner margin whitish buff, the cilia white. Wings below grayish olive, the cilia white, the fore wing white at apex, and slightly so on terminal interspaces; a black line along costal edge, not reaching apex; the hind wing whitish at base.

Expanse, 53 mm.

*Habitat*.—Incachaca, Bolivia.

*Type*.—U.S.N.M. no. 34650.

Allied to *M. cloacina* Dognin. Described from eight specimens.

**MERAGISA CAMIOLA, new species**

*Male*.—Head and collar pale mauve-gray; thorax fuscous, almost completely hidden by the white patagia mottled with mouse-gray hairs. Abdomen above benzo brown with pale segmental lines; the last two segments and anal hairs like patagia. Body below buffish white. Fore wing white irrorated with mouse gray, the lines fine, mostly black; subbasal line outcurved on costa, incurved below cell and followed by a very faint grayish shade; antemedial double, slightly outcurved from costa to median, then sinuous, filled in with avellaneous; traces of a faint lunular medial line; postmedial line outcurved on costa, double, lunular, dentate, filled in with avellaneous,



very irregular to middle of inner margin, closely followed by the subterminal line to vein 3; a terminal line well incurved between each terminal space; cilia white. Hind wing chaetura drab, the inner margin aniline yellow; a black medial line, double at anal angle; cilia white. Fore wing below dark grayish olive; costa, termen, and inner margin white. Hind wing below a cartridge buff; the termen broadly dark grayish olive, broadest at costa, with a streak proximally at vein 6; termen and cilia white.

Expanse, 44 mm.

*Habitat*.—Campo Bello, Brazil.

*Type*.—U.S.N.M. no. 34649.

Received from my friend J. F. Zikan.

**MERAGISA LUCEDIA, new species**

*Female*.—Head, collar, thorax, and base of abdomen pale ecru-buff; abdomen above similar with transverse lines of clay color; body below pale ecru-drab. Fore wing with base white crossed by a fine, dentate, subbasal line, and limited by a fine double antemedial line outbent from costa to middle of inner margin; the space beyond vinaceous-buff; postmedial line like antemedial, inbent from costa to vein 6, vertical to vein 5 and outbent to inner margin close to tornus; terminal oblique dark lines on interspaces inwardly edged with white; a small cinnamon-drab spot at discocellular; dark points on costa from before postmedial line to apex. Hind wing light brownish drab, the margins suffused with whitish on termen between the veins. Fore wing below brownish drab, the inner margin broadly white, narrower and terminating in a point at tornus. Hind wing below whitish irrorated with light brownish drab, forming a vague post-medial curved fascia.

Expanse, 42 mm.

*Habitat*.—Cuba.

*Type*.—U.S.N.M. no. 34645.

Nearest *M. valdiviesoi* Dognin.

**MERAGISA RAHULANA, new species**

*Male*.—Palpi light gray, with a lateral black streak on third segment; vertex with a black transverse line. Collar and thorax grayish olive, mottled with smoke gray; the thorax below and the legs chamois. Abdomen above light pinkish cinnamon at base, the medial segments with the hair brown and with faint paler segmental lines, the last segment and anal hairs white mottled with dark-gray hairs; abdomen below colonial buff. Fore wing white irrorated with gray and black scales; a fine dark basal line followed by black points; a double black antemedial line wavyly outbent on costa, inbent in cell, with black points on discocellular and at vein 2, followed by some diffuse dark

shading; an outangled postmedial line on costa, followed by a series of black points, forming an irregular line, and this followed by diffuse dark gray shading; some marginal dark points; a terminal black lunular dentate line partly broken; the cilia from apex to vein 3 with paired dark lines from tips of veins. Hind wing deep grayish olive, the inner margin light pinkish cinnamon; termen vinaceous-white, proximally dentate. Fore wing below grayish olive, the costal edge, termen narrowly, base below cell and basal half of inner margin whitish yellow; cilia white. Hind wing below whitish yellow, the termen broadly grayish olive, expanding toward base on costal margin.

Expanse, 48 mm.

*Habitat*.—Hansa Humboldt, Brazil.

*Type*.—U.S.N.M. no. 34648.

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**MERAGISA SINDANA**, new species

*Male*.—Head, collar, and patagia white mottled with light mouse-gray hairs; collar behind medially fuscous. Abdomen above with the hair brown and with faint paler transverse lines, the anal segment and hairs whitish gray with darker transverse line; body underneath buff white, the abdomen with grayish transverse bands. Fore wing, broadly at apex and on inner margin, light cinnamon-drab; costal edge white with the lines on it fuscous; base white from cell to inner margin, with some black points; antemedial line double, filled in with dark cinnamon-drab, wavyly outbent from costa to median vein; below cell an outcurved white line; medial punctiform lines on costa; postmedial line double, finely lunular, excurved below vein 4 and again incurved, outwardly followed by black points from vein 4 to costa; an irregular subterminal series of black spots and wavy lines; some terminal black spots. Hind wing: Some whitish suffusions on basal third; a dark outcurved antemedial line downbent to anal angle; termen broadly glossy, with the hair brown; cilia white. Fore wing below drab; costa buffish; a fuscous terminal line; cilia pale buff. Hind wing below light buff with a postmedial, outcurved and moderately broad, drab shade.

Expanse, 46 mm.

*Habitat*.—Pueblo Guasca, Bogota, Colombia.

*Type*.—U.S.N.M. no. 34647.

Three specimens.

**Genus RIFARGIA** Walker

**RIFARGIA CALVESTA**, new species

*Female*.—Palpi laterally fuscous, underneath and above white; vertex white with dark irrorations; collar grayish olive mottled with white. Thorax mostly olive-brown, the patagia dorsally edged with

black, the metathorax with a transverse black line. Abdomen dorsally cinnamon-buff at base followed by dark shading, the terminal segments pale drab-gray with fine whitish transverse lines; underneath pinkish buff. Fore wing with an oblique fascia from base of costa to tornus and termen, very pale smoke gray mottled with some darker fine scales; an irregular basal black line; a small subbasal black spot below cell; a double fuscous antemedial line interrupted by veins; a double medial black line filled in with olive-brown; a whitish spot at end of cell edged with lateral black lines, the costa above it drab-gray; postmedial fascia dusky drab from costa to vein 3, proximally edged by a fine dark line, and crossed by a conspicuous macular black line, with a similar spot inset between veins 3 and 2; termen toward apex with fine darker scales; a subterminal black line interrupted by veins from costa to vein 3; the tips of veins with paired black points. Hind wing with the hair brown, the base of costa and suffusions along inner margin white.

Expanse, 40 mm.

*Habitat*.—Itatiaia, Brazil.

*Type*.—U.S.N.M. no. 34683.

Received from J. F. Zikan. Somewhat like *R. variegata* Dognin.

**RIFARGIA ALICIATA, new species**

*Male*.—Palpi fuscous, fringed with white; frons and vertex mottled white and gray; front of collar fuscous, vinaceous-cinnamon posteriorly. Thorax light cinnamon-drab, fuscous dorsally. Abdomen above dusky drab with a few buff spots, the terminal segments and anal hairs white with a few fuscous scales; venter of abdomen pale grayish vinaceous. Fore wing cream white; a wavy fuscous line from base of costa to inner margin antemedially; a triangular antemedial fuscous spot on costa, and from it a wavy line upcurved to a similar large quadrate spot from costa to vein 4, the line extending slightly distally on costa and with three grayish spots on costal edge; a small marginal spot above vein 2; a fine black terminal line interrupted by veins, and connecting with dark spots on the white cilia. Hind wing drab with white suffusions at base, beyond cell and at anal angle; the inner margin and cilia white. Wings below white. Fore wing above median and vein 2 dusky vinaceous, this coloring not reaching termen. Hind wing with the termen narrowly dusky vinaceous.

Expanse, 53 mm.

*Habitat*.—New Bremen, Santa Catharina, Brazil.

*Type*.—U.S.N.M. no. 34658.

Two specimens, collected by Fritz Hoffmann.

## RIFARGIA ALANIA, new species

*Male*.—Head, collar, and thorax ecru-drab mottled with army brown; a small spot on vertex and a line across front of collar fuscous; a large triangular space on thorax posteriorly benzo brown and a similar small spot dorsally on basal segment of abdomen, the latter light plumbago gray dorsally, with darker transverse shades leaving the segmental lines pale; abdomen below pale vinaceous-gray. Fore wing partly white; a fine double subbasal black line from costa to submedian, preceded by a small dark gray spot below cell edged above by a curved black line, followed by a thicker antemedial black line from costa to submedian, the space below submedian white from base to tornus; the antemedial line followed by a vinaceous-buff shade to submedian, distally edged by a double fine lunular line; above it a broad oblique fascia which is light cinnamon-drab on costa, and then grayish olive from within cell to below vein 2 where it ends in a black point; a colonial buff space below the fascia, and between cell and submedian, extending to postmedial line; the oblique fascia broadly edged by white from costa to postmedial line; above it a large dark mottled spot, not reaching costa; the postmedial line fine, ochraceous-salmon, sinuous; subterminal space from below costa broadly white with some pale olive gray suffusions, more intense toward vein 2, at tornus reduced to an oblique streak, the whole limited by the rather broad termen and the cilia which are vinaceous-buff with black points on the interspaces expanding into large spots on cilia; dark points on submedian vein with short streaks below the vein. Hind wing with base, medial space below vein 6 to vein 2, and the inner margin buffish white, the terminal space broadly brownish drab, the cilia whitish. Fore wing below cinnamon-drab; a broad oblique white fascia from cell and vein 2 to tornus; the apex, termen narrowly and cilia pale ecru drab. Hind wing below with the inner margin broadly white, the termen broadly cinnamon-drab, widest at apex, the termen narrowly and cilia pale ecru-drab.

Expanse, 52 mm.

*Habitat*.—Minas Geraes, Brazil.

*Type*.—U.S.N.M. no. 34661.

## RIFARGIA TERTINI, new species

*Male*.—Palpi fuscous tipped with pale pinkish buff; collar pinkish buff crossed by a broad fuscous band. Thorax black, also the dorsal tips of the grayish-white patagia; the metathorax tipped with pinkish buff hairs. Abdomen above pale ecru-drab, underneath white. Fore wing above pale ecru-drab irrorated with dark scales and crossed by fine double black lines; a single fine basal line; antemedial line lunular, dentate; an angled velvety black line at discocellular, preceded

by a small black spot in cell; postmedial line straight from costa to vein 3, then lunular and incurved to inner margin, the outer part of the line somewhat dentate from costa to vein 3, followed by fuscous elongated spots on the interspaces; the space beyond suffused with brown and black spots; a thick black subterminal line inangled at vein 5, and lunular from vein 4 to tornus on a pale background; a black point above tornus. Hind wing white, the hair on termen brown; cilia white. Fore wing below glossy quaker drab, the terminal interspaces, cell and inner margin white. Hind wing below white, the dark termen narrower than on upper side.

Expanse, 40 mm.

*Habitat*.—Hansa Humboldt, Brazil.

*Type*.—U.S.N.M. no. 34667.

### Genus EUHARPYIA Schaus

#### EUHARPYIA AHAZICHA, new species

*Male*.—Tuft of hair at base of antenna mottled avellaneous and fuscous; head and collar fuscous, the latter with white scales laterally and behind. Patagia mostly white dorsally, broadly edged with the light vinaceous-drab. Abdomen above dark grayish brown, the terminal segments and underside whitish. Fore wing with base broadly pinkish buff on costa, this area limited by a curved line to near base of inner margin; a short black basal streak on costa, a fainter streak below it, and a longer streak above inner margin nearly connected with the curved line and forming a small triangle on costa; space beyond, from costa to near submedian, whitish, crossed by a postmedial pale ecru-drab shade; apex broadly light brownish drab; a subterminal fine black line, preceded between veins 4 and 5 by a black spot, and followed by black spots between veins 4 and 6; a trace of a dark spot above tornus. Hind wing grayish white suffused with light cinnamon-drab at apex, and with dark spots at apex, on vein 5 and at anal angle; the inner margin with a deep grayish-olive streak. Fore wing below light cinnamon-drab, the costa terminally and apex light buff. Hind wing below white.

Expanse, 42 mm.

*Female*.—Body as in the male. Fore wing with the base as in the male, but without the basal dark streaks, and the fuscous line not so deeply curved basad, this line followed by a curved series of white spots to inner margin; the apex and terminal spots as in the male. Hind wing slightly avellaneous at base, becoming buff-brown on termen; cilia whitish. Fore wing below as in the male but slightly darker. Hind wing below with the costa broadly, and termen more narrowly, light cinnamon-drab; otherwise dull whitish.

Expanse, female 43 mm.

*Habitat*.—Male, Hansa Humboldt, Brazil; female, Santa Catharina, Brazil.

*Type*.—U.S.N.M. no. 34669.

Allied to *E. comita* Schaus.

**Genus EUNOTELA Schaus**

**EUNOTELA GRISELLANA, new species**

*Female*.—Palpi light drab; vertex lilacine white; collar black. Thorax white irrorated with black and drab-gray scales. Abdomen above dark grayish brown, some white hairs dorsally at base, the terminal segments white irrorated with dark scales, forming a small dorsal dark spot, the last segment with lateral fuscous spots, the anal hairs tipped with fuscous. Body below mostly ecru-drab, the abdomen with darker mottling and a lateral black line. Fore wing white with some drab-gray irrorations, chiefly antemedially and along inner margin; antemedial line fine, light drab, proximally dark edged, vertical, followed in cell and below median by a series of black points; medial line fine, black, double, slightly outbent on costa, then curved somewhat and faintly sinuous to inner margin; a black line on discocellular, a weak dark line above it on costa, and a dark line beyond it from vein 6 to vein 4; postmedial line fine, minutely wavy, outcurved slightly to inner margin; a subterminal fine black line, faintly sinuous; a few black terminal lines on interspaces. Hind wing white with slight ecru-drab suffusions at apex, and a small spot at anal angle. Fore wing below mostly brownish drab with ecru-drab streaks on interspaces postmedially and subterminally, with a postmedial dark shade. Hind wing below white; a short postmedial light brownish drab line from costa to vein 6, with irrorations along costa, and more weakly on termen.

Expanse, 45 mm.

*Habitat*.—Hansa Humboldt, Brazil.

*Type*.—U.S.N.M. no. 34666.

Allied to *E. pallida* Schaus and *E. zophara* Schaus.

**Genus HYPERAESCHRA Butler**

**HYPERAESCHRA LAMIDA, new species**

*Male*.—Head and thorax grayish olive. Abdomen above dark olive-buff, underneath white. Fore wing with base pale buff-brown, mottled with grayish scales; a double black basal line on costa, slightly outbent below cell to a small fuscous spot; a very irregular double antemedial line followed on costa by a large triangular deep olive patch, the latter followed on costa by gray scaling, and in end of cell by white scales; a black postmedial line well outbent from costa,

curved across vein 5 and downbent to vein 2, then incurved to inner margin, and partly bordered outwardly with clusters of white scales; termen mostly light brown and dark olive-buff; an interrupted terminal black line; the apex edged with white; the markings all very confused. Hind wing buff-brown on inner margin, the medial space wood brown, the costa and apex faintly whitish. Wings below cream color, the fore wing suffused with brownish drab below costa.

Expanse, 42 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 34675.

Received from J. F. Zikan.

### Genus KASERIA Schaus

#### KASERIA DICOLIS, new species

*Male*.—Palpi and base of throat fuscous. Vertex mouse gray, laterally white. Collar and patagia white mottled with mouse gray, thorax fuscous. Abdomen above snuff brown with transverse mouse-gray lines, underneath white with drab-gray lines. Fore wing white with a few brownish irrorations; a fine, faint, wavy antemedial line; a postmedial quadrate dark spot on costa, with a somewhat prolonged branch distally below subcostal, from which the postmedial benzo-brown lunular line is downbent to vein 3, below which it forms a fuscous line proximally and is outcurved to the tornus; the postmedial preceded from subcostal to vein 3 by avellaneous irrorations, and distally double above vein 5; termen mouse gray proximally, edged by sinuous dark scaling, and with marginal olive-brown irregular lines. Hind wing white with very faint grayish suffusions on termen. Wings below white. Fore wing with the costal edge dusky brown; a postmedial cinnamon patch from costa to vein 4 and similar irrorations on termen.

Expanse, 29 mm.

*Habitat*.—Jaragua do Sul, Brazil.

*Type*.—U.S.N.M. no. 34676.

### Genus HEMICERAS Guénée

#### HEMICERAS GERAESA, new species

*Female*.—Head, thorax, and abdomen light cinnamon-drab, the last with darker transverse lines dorsally and colonial buff underneath. Fore wing cinnamon-drab, somewhat roseate terminally and before the outer line; some grayish irrorations; a fine dark brown antemedial line slightly outbent, the outer line dark brown, distally pale-edged from costa near apex to inner margin near antemedial; a fine fuscous line on discocellular; the veins from cell to termen fuscous: faint

darker irregular lines on termen. Hind wing pale vinaceous-fawn, the veins, inner margin and termen narrowly cinnamon-drab, the cilia vinaceous-white. Fore wing below avellaneous, the inner margin white. Hind wing below white.

Expanse, 50 mm.

*Habitat*.—Virginia, Minas Geraes, Brazil.

*Type*.—U.S.N.M. no. 30651.

Received from J. F. Zikan.

HEMICERAS BENICA, new species

*Male*.—Head vinaceous-buff. Collar and thorax nearest ecru-drab. Abdomen above light drab, underneath vinaceous-buff. Fore legs with white tufts. Fore wing glossy avellaneous with mottled darker irrorations; a vertical fine dark brown antemedial line proximally edged with pale vinaceous; a fine outbent dark line on discocellular; postmedial line from apex, inbent, straight to middle of inner margin, fine, dark, but pale-edged distally; termen largely with darker suffusions, the tornus paler; the inner margin slightly lobed near base and somewhat excurved to tornus. Hind wing whitish along costa, then suffused with vinaceous-buff, avellaneous on inner margin; stigma deep brownish drab. Fore wing below with base and inner margin broadly white, otherwise brownish vinaceous. Hind wing below white with a short roseate streak at sigma.

Expanse, 40 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 34657.

Received from J. F. Zikan.

HEMICERAS GUERA, new species

*Male*.—Head and thorax vinaceous-buff. Abdomen vinaceous-fawn. Fore wing vinaceous-buff; an antemedial outcurved punctiform fuscous line; a dark line on discocellular; outer line from costa well before apex, punctiform, black, sinuous to vein 2, then slightly inbent to inner margin near the antemedial line; subterminal dark shading extending from costa to vein 4, then outbent and downbent to termen. Hind wing white with slight vinaceous-buff suffusions terminally. Wings below whitish, the cilia on fore wing finely fuscous brown.

Expanse, 32 mm.

*Habitat*.—Moengo, Cottica River, Surinam.

*Type*.—U.S.N.M. no. 34653.

*Paratypes*.—Male and female paratypes, Carnegie Museum no. 7975, Kartabo, Surinam. The male paratype is badly rubbed; the female is in perfect condition.



## HEMICERAS CHABILA, new species

*Male*.—Head and front of collar chestnut; the collar posteriorly and the thorax cinnamon-drab. Abdomen dorsally at base and the anal hairs avellaneous, otherwise wood brown; underneath vinaceous-buff. Fore wing ochraceous-tawny with dark suffusions and numerous paler transverse striae; lines fine, black, the antemedial outcurved on costa, sinuous below cell; a narrow dark spot on discocellular; post-medial line from costa near apex, slightly curved to middle of inner margin, distally faintly edged with vinaceous; small dark terminal spots on veins; the inner margin straight. Hind wing roseate-brown, the costal margin white, the cilia white; no stigma. Fore wing below glossy, light russet-vinaceous, the base and inner margin white. Hind wing below white.

Expanse, 36 mm.

*Habitat*.—Itatiaya, Brazil.

*Type*.—U.S.N.M. no. 34655.

Received from J. F. Zikan.

## HEMICERAS CAYABA, new species

*Male*.—Palpi light cinnamon-drab, the basal joint white; head bluish white; collar cinnamon-buff edged behind with black. Thorax medially sayal brown, the patagia cinnamon-buff, dorsally edged with black, tipped with bluish-white hairs, which are also clustered on the metathorax. Abdomen above with the hair brown, the anal hairs pinkish buff; underneath white. Fore wing glossy tawny-olive; the inner margin excurved before tornus; some white hairs at base of inner margin; antemedial black points in a sinuous line, followed on one wing at submedian by a black spot; a faint dark line on discocellular; a row of black points on veins from costa before apex to vein 2, then incurved as a black line to inner margin, where it is followed by a broader fuscous line; inner margin mostly edged with black, the costa partly finely edged with white. Hind wing white, suffused with light russet-vinaceous, becoming clay color on termen; the stigma fuscous. Fore wing below on inner margin and apex whitish; a light cinnamon-drab shade before apex. Hind wing below pallid purple-drab.

Expanse, 40 mm.

*Habitat*.—Espírito Santo, Brazil.

*Type*.—U.S.N.M. no. 34673.

One male and two females.





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